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Geology, Energy, and Mineral (GEM) Resource Evaluation of the Snake River GRA, Idaho, including the Table Rock Islands (34-2 Pine Creek Islands (34-3), and Conant Valley Islands (34-4) Wilderness Study Areas

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PHASE I

Geology, Energy, and Mineral (GEM) Resource Evaluation of the Snake River GRA, Idaho, including the Table Rock Islands (34-2), Pine Creek Islands (34-3), and Conant Valley Islands (34-4) Wilderness Study Areas

Bureau of Land Management
Contract No. YA-553-CT2-1039

By:

G. Fernette
R.S. Fredericksen

Contributors:

D. Blackwell
G. Webster
J. Bressler
J. Stratman
C.G. Bigelow
W. Jones
J.F. McOuat
E.F. Evoy

ANCHORAGE, ALASKA
AUGUST 1983

WGM INC.
MINING AND GEOLOGICAL CONSULTANTS

EXECUTIVE SUMMARY

The Snake River GRA is in the Idaho Falls BLM district. The GRA encompasses an area around the Snake River in Bonneville County and includes three Wilderness Study Areas: Table Rock Islands (34-2), Pine Creek Islands (34-3) and Conant Valley Islands (34-4). The WSAs comprise over 40 islands along a 25 mile long segment of the Snake River and total 770 acres.

The WSAs are underlain by recently deposited Snake River gravels, several thousand feet of volcanics and coarse clastics. Bedrock in the Snake River GRA consists mostly of a thick section of folded and faulted sedimentary rocks partly overlain by younger volcanic rocks. Presumably, the folded and faulted sedimentary rocks are also present under the WSAs at depth. Structurally, the valley of the Snake River is a graben. Displacement on the bounding faults is several thousands of feet.

Gold, limestone, cinders and sand and gravel have been mined in the past in the Snake River GRA. Other mineral occurrences include phosphate, uranium, vanadium, coal, clay and travertine. One exploratory oil or gas well was drilled in the GRA and there is one thermal spring.

The only significant metallic resource potential in the WSAs is for deposits of placer gold. There may be some potential for uranium in the Quaternary and Tertiary volcanics and coarse clastics underlying the WSAs, but no data is available on which to base an assessment. There is moderate potential for oil and gas and geothermal resources in the subsurface of the WSAs, but these could probably be developed from outside the WSA boundaries. The WSAs

are entirely underlain by sand and gravel, but these resources are abundant elsewhere in the region. The classification of the land within the WSAs is summarized in the accompanying table.

SUMMARY OF GEM RESOURCES

LAND CLASSIFICATION FOR THE SNAKE RIVER GRA

	Table Rock Islands (34-2)	Pine Creek Islands (34-3)	Conant Valley Islands (34-4)
1. Locatable Resources			
a. Metallic Minerals	3D	3D	3D
b. Uranuim and Thorium	2A	2A	2A
c. Non-Metallic Minerals	1D	1D	1D
2. Leasable Resources			
a. Oil and Gas	3C	3C	3C
b. Low Temperature Geothermal	3B	3B	3B
High Temperature Geothermal	3B	3B	3B
c. Sodium and Potassium	1D	1D	1D
d. Other	1D	1D	1D
3. Saleable Resources	4D	4D	4D

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SNAKE RIVER GRA, IDAHO

1.0 INTRODUCTION

The Bureau of Land Management has adopted a two-phase procedure for the integration of geological, energy and minerals (GEM) resources data into the suitable/non-suitable decision-making process for Wilderness Study Area (WSAs). The objective of Phase I is the evaluation of existing data both published and available unpublished data, for interpretation of the GEM resources potential of the WSAs. Wilderness Study Areas are grouped into areas based ong eologic environment and mineral resources for initial evaluation. These areas are referred to as Geology, Energy, Mineral Resource Areas (GRAs).

The delineation of the GRAs is based on three criteria: (1) a 1:250,000 scale mape of each GRA shall be no greater than 8½ x 11 inches; (2) a GRA boundary will not cut across a Wilderness Study Area; and (3) the geologic environment and mineral occurrences. The data for each GRA is collected, compiled, and evaluated and a report prepared for each GRA. Each WSA in the GRA is then classified according to GEM resources favorability. The classification system and report format are specified by the BLM to maintain continuity between regions.

This report is prepared for the Bureau of Land Management under contract number YA-553-CT2-1039. The contract covers GEM Region 2; Northern Rocky Mountains (Fig. 1). The Region includes 50 BLM Wilderness Study Areas

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Snake River GRA, Idaho Location Map

SCALE 1"= 45 MILES			FIGURE 1
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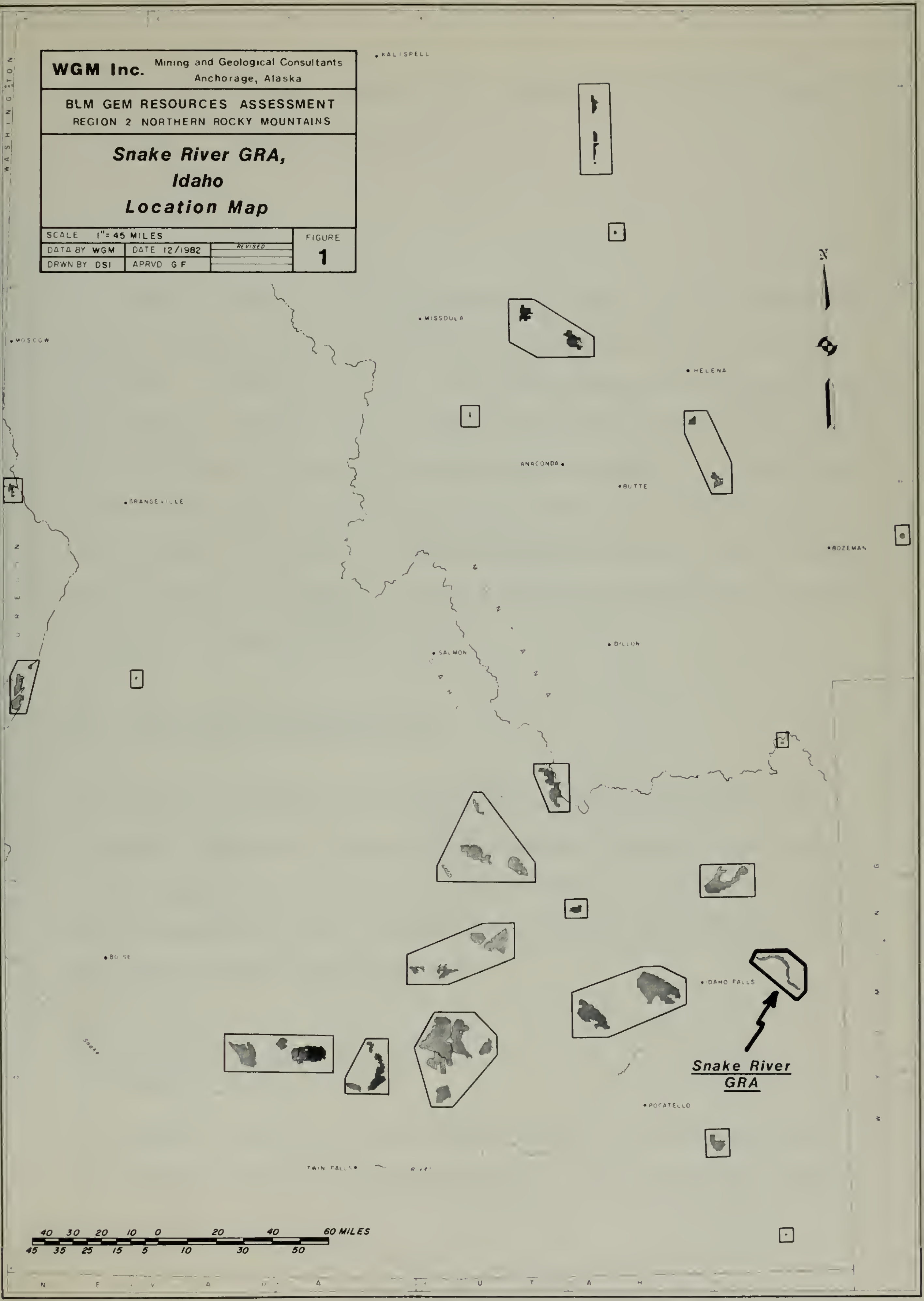


totalling 583,182 acres. The WSAs were grouped into 22 GRAs for purposes of the Phase I GEM resources evaluation.

1.1 Location

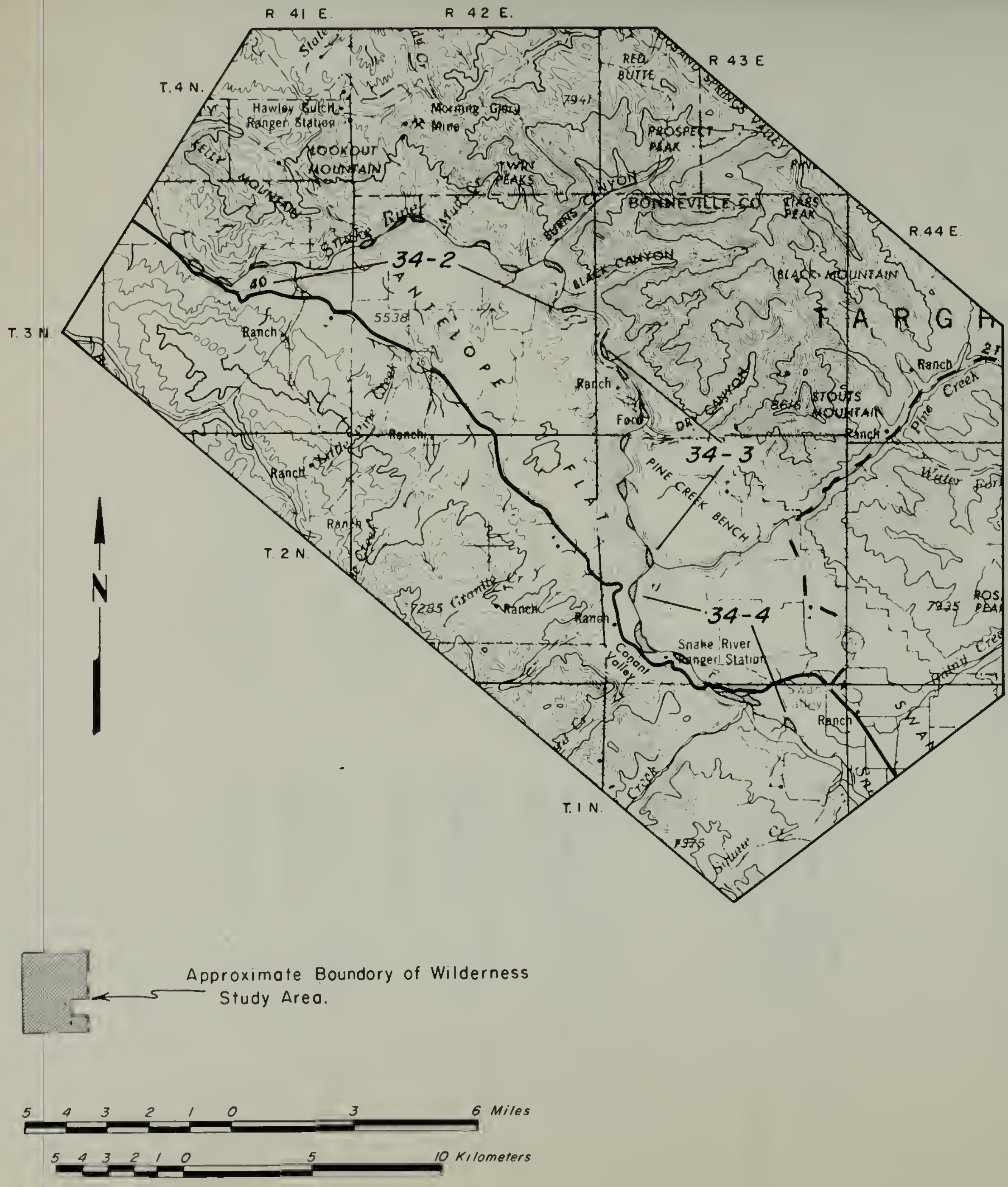
The Snake River GRA is located in southeastern Idaho primarily in Bonneville County although parts of Teton, Madison, and Jefferson Counties are also included. The GRA is in Ts.1-4N., Rs.40-44E. encompassing Antelope Flat and Swan Valley on the Snake River, 12 miles below the Palisades Reservoir (Fig. 2). The GRA contains three Wilderness Study Areas (WSAs): the Table Rock Islands (380 acres), the Pine Creek Islands (155 acres), and the Conant Valley Islands (235 acres). The WSAs encompass a series of over 40 islands along a 25 mile long segment of the Snake River. Administratively the area is within the Idaho Falls BLM district.

1.2 Population and Infrastructure

Swan Valley, population 135, is the largest settlement within the Snake River GRA. The area is about equidistant between Idaho Falls, Idaho and Jackson, Wyoming and is transected by U.S. Highway 26 and State Highway 31. Numerous secondary roads are present in the area and much of the land in the GRA is developed for agricultural use.

1.3 Basis of the Report

This report is based on a review, compilation and analysis of available published and unpublished data on the geology, energy and mineral resources



BLM Wilderness Study Areas Included in the Snake River GRA.

WSA	NAME	ACREAGE
34-2	Table Rock Islands	380
34-3	Pine Creek Islands	155
34-4	Conant Valley Islands	235

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Snake River GRA, Idaho

Topographic Map

SCALE 1" = 4 MILES
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FIGURE 2

of the Snake River GRA. The area has a limited mining history; and it has been the subject of several geologic studies. Portions of the GRA were studied by Savage (1961) who investigated the geology and mineral deposits of Bonneville County. None of the area is covered by NURE reports. Mining claim and oil and gas information were compiled from BLM land records. Areal photographs loaned to WGM by the BLM were also reviewed. No field examination was conducted by WGM geologists as part of this evaluation.

The data was compiled and reviewed by WGM project personnel and the Panel of Experts to produce the resource evaluation which follows. Personnel involved in the project and their general areas of responsibility are listed below:

Greg Fernette, Senior Geologist, WGM Inc.	Project Manager
C.G. Bigelow, President, WGM Inc.	Chairman, Panel of Experts
Joel Stratman, Geologist, WGM Inc.	Project Geologist
Jami Fernette, Land and Environmental Coordinator, WGM Inc.	Claims and Lease Compilation

Panel of Experts

C.G. Bigelow, President, WGM Inc.	Regional geology, metallic and minerals, mineral economics.
R.S. Fredericksen, Senior Geologist, WGM Inc.	Regional geology, metallic minerals.
David Blackwell, Ph.D., Professional of Geophysics, Southern Methodist University	Geothermal.
Jason Bressler, Senior Geologist, WGM Inc.	Regional geology, metallic minerals.
Gary Webster, Ph.D., Chairman, Department of Geology, Washington State University	Oil and gas.

William Jones, Senior Geologist, WGM Inc.	Metallic minerals, coal, industrials.
J.F. McOuat, Presidents, Watts, Griffis & McOuat Ltd.	Mineral economics, and industrial minerals.
E.F. Evoy, Presidents, Watts, Griffis & Griffis & McOuat Ltd.	Uranium and thorium.

1.4 Acknowledgements

We would like to thank Tim Carroll, District Geologist for the Idaho Falls BLM district for assistance in the compilation phase of this project.

2.0 GEOLOGY

2.1 Introduction

Rocks from Cambrian (600-500 m.y.) through Tertiary (65-2 m.y.) age underlie the Snake River GRA. Thick sections of Paleozoic (600-230 m.y.) , Mesozoic (230-65 m.y.), and Tertiary sedimentary carbonates and clastic rocks are present. The WSAs are comprised principally of fluvial and alluvial deposits of Quaternary (2 m.y.-present) to Holocene (0.1 m.y.-present) age underlain by Tertiary to Quaternary basalt and conglomerate. Structurally the area is comprised of folded, complexly faulted, and block faulted rock units. The predominant structural trend is northwest-southeast. The Snake River flows northwest in a broad valley controlled by the Swan-Grand Valley graben.

Geologic mapping of the Snake River GRA and immediately adjacent area includes the work of Kirkham (1924), Mansfield (1927), Vine (1959), Savage (1961), Jobin and Schroeder (1964), Staatz and Albee (1966), Pampayan et al. (1967), and Scott (1981). Parts of all of these maps were incorporated by Mitchell and Bennett (1979) in the compilation map of the Driggs 2° Quadrangle, which forms the basis for Figures 3 and 4.

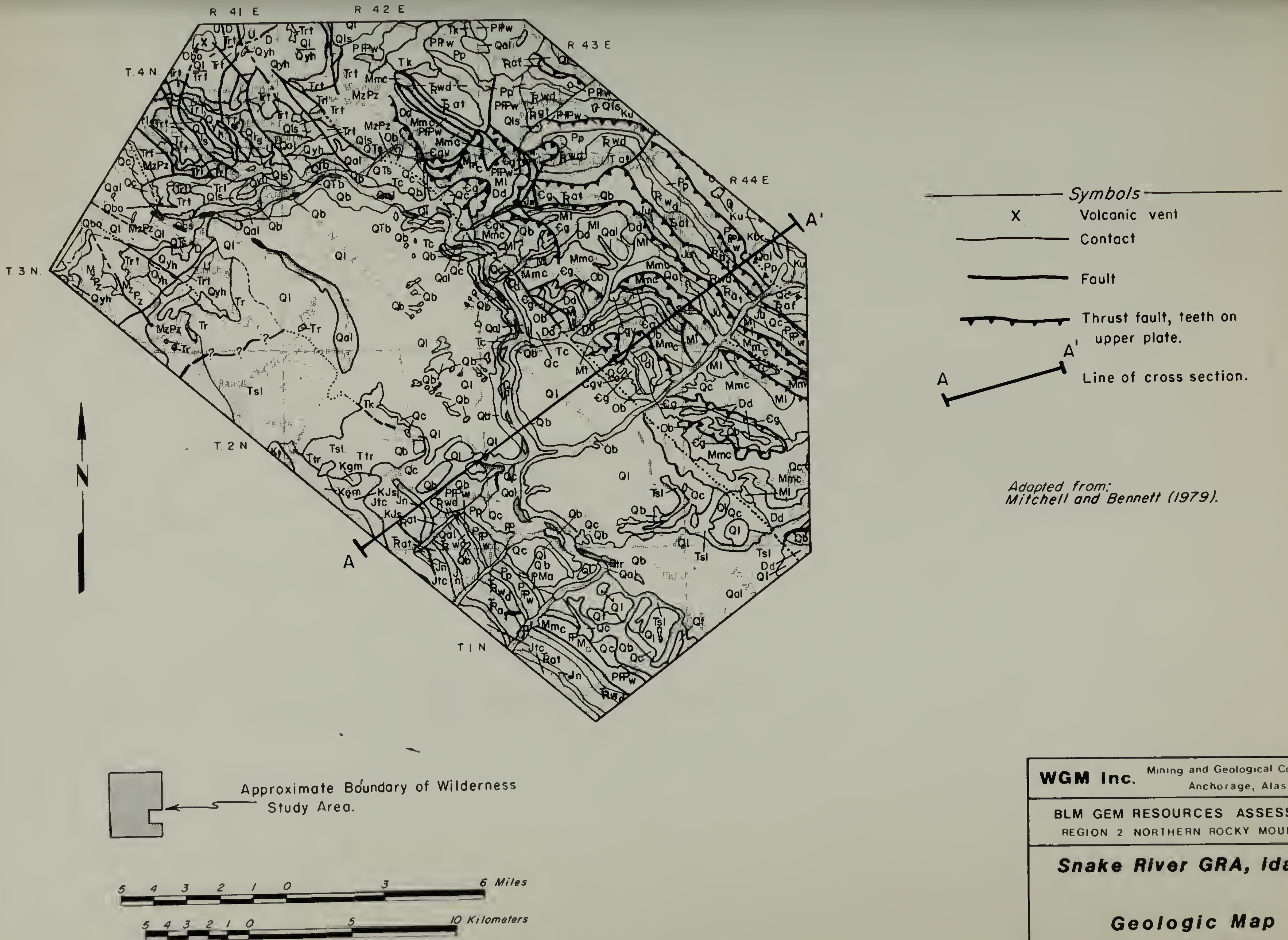
2.2 Physiography

The Snake River GRA is within the Middle Rocky Mountains subprovince of the Rocky Mountains and Wyoming Basin physiographic province (Hunt, 1974)(Fig. 5). The principal topographic feature in the GRA is Swan Valley which

Snake River GRA, Idaho
Explanation for Figure 3 and 4

Era	Group	Sedimentary		Igneous		Epoch / Period	Period
CENOZOIC		Qal	Stream Alluvium			Recent	
		Qls	Landslide debris				
		Qf	Alluvial fan deposits				
		Qc	Colluvium	Qb	Olivine basalt	Pleistocene	Quaternary
		Ql	Loess	Qba	Basalt, localized flows, minor interlayered sediments and basaltic pyroclastic deposits		
		QTs	Tuffaceous sediments	Qyh	Huckleberry Ridge Tuff		
		Tsl	Salt Lake Formation	Tr | Trt | Trl Trt Tk	Tr-Rhyolite Trt-Rhyolite tuff Trl-Rhyolite lava Rhyolite and Trachyte Kirkham Hollow Volcanics	Pliocene	Tertiary
		Tc	Conglomerate				
MESOZOIC		Kw	Wayan Formation			Cretaceous	
		Kgm	Draney Limestone, Bechler Formation, and Peterson Limestone	Ku	Cretaceous rocks, undifferentiated		
		Kbr	Bear River Formation and red shale				
		KJs	Ephraim Conglomerate, Stump Sandstone, and Preuss Sandstone				
		JTc	Twin Creek Limestone	Ju	Jurassic rocks undifferentiated	Jurassic	
		Jn	Nugget Sandstone				
		T̄R at	Ankareh Shale and Thaynes Formation	T̄Ru	Triassic rocks, undifferentiated	Triassic	
		T̄R wd	Woodside Formation and Dinwoody Formation	MzPz	Mesozoic and Paleozoic rocks, undifferentiated		
PALEOZOIC		Pp	Phosphoria Formation and related rocks			Permian	
		Pℙw	Wells Formation and associated rocks			Pennsylvanian	
		ℙMa	Amsden Formation	Mℙu	Mississippian and Pennsylvanian rocks, undifferentiated		
	Madison	Mmc	Mission Canyon Limestone	Pz	Paleozoic rocks, undifferentiated	Mississippian	
		Ml	Lodgepole Limestone				
		Dd	Darby Formation			Devonian	
		Ob	Bighorn Dolomite			Ordovician	
		Ꞓg	Gallatin Limestone			Cambrian	
		Ꞓgv	Gros Ventre Formation				

Data by: Mitchell and Bennett, 1979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R 42 E
R 43 E
R 44 E
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T. 3 N.
T. 2 N
T 1 N
A
A'
N
Symbols
X Volcanic vent
Contact
Fault
Thrust fault, teeth on upper plate.
A A' Line of cross section.
Approximate Boundary of Wilderness Study Area.
5 4 3 2 1 0 3 6 Miles
5 4 3 2 1 0 5 10 Kilometers

Adapted from:
Mitchell and Bennett (1979).

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Snake River GRA, Idaho

Geologic Map

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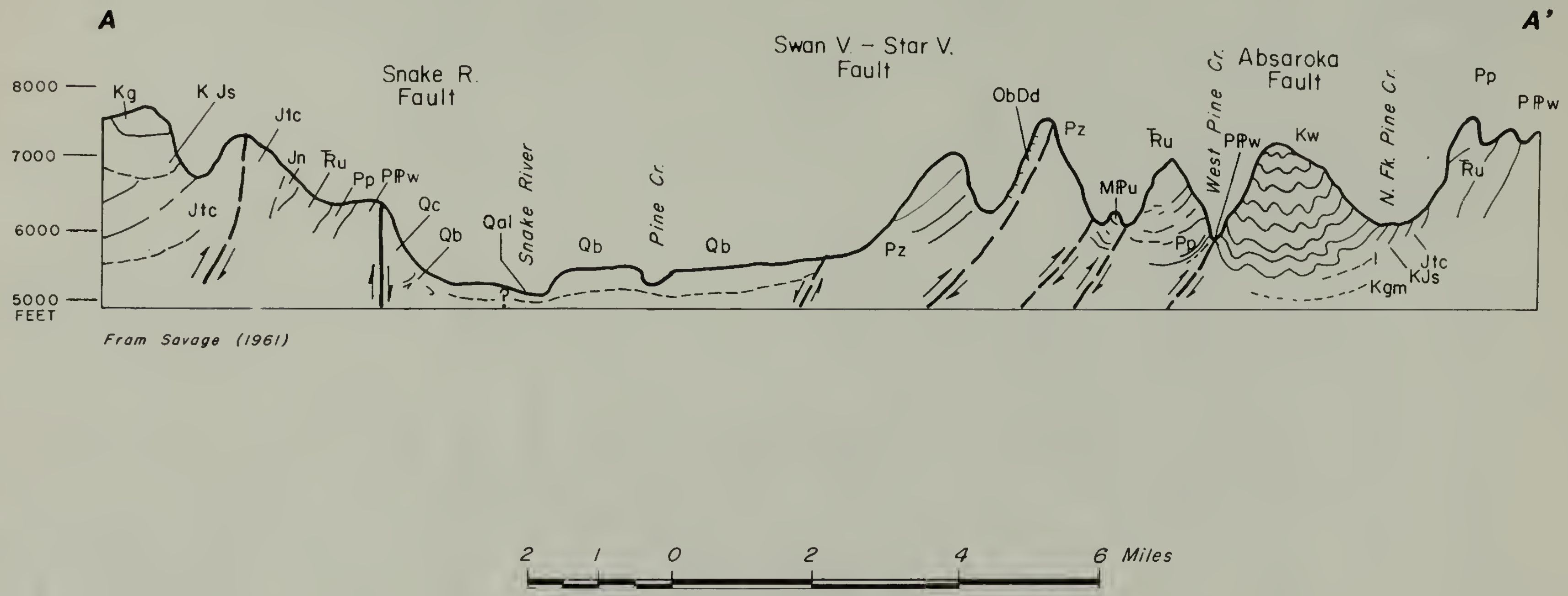
Section A - A'



From Savage (1961)

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Snake River GRA, Idaho

Geologic Cross Section

SCALE AS SHOWN
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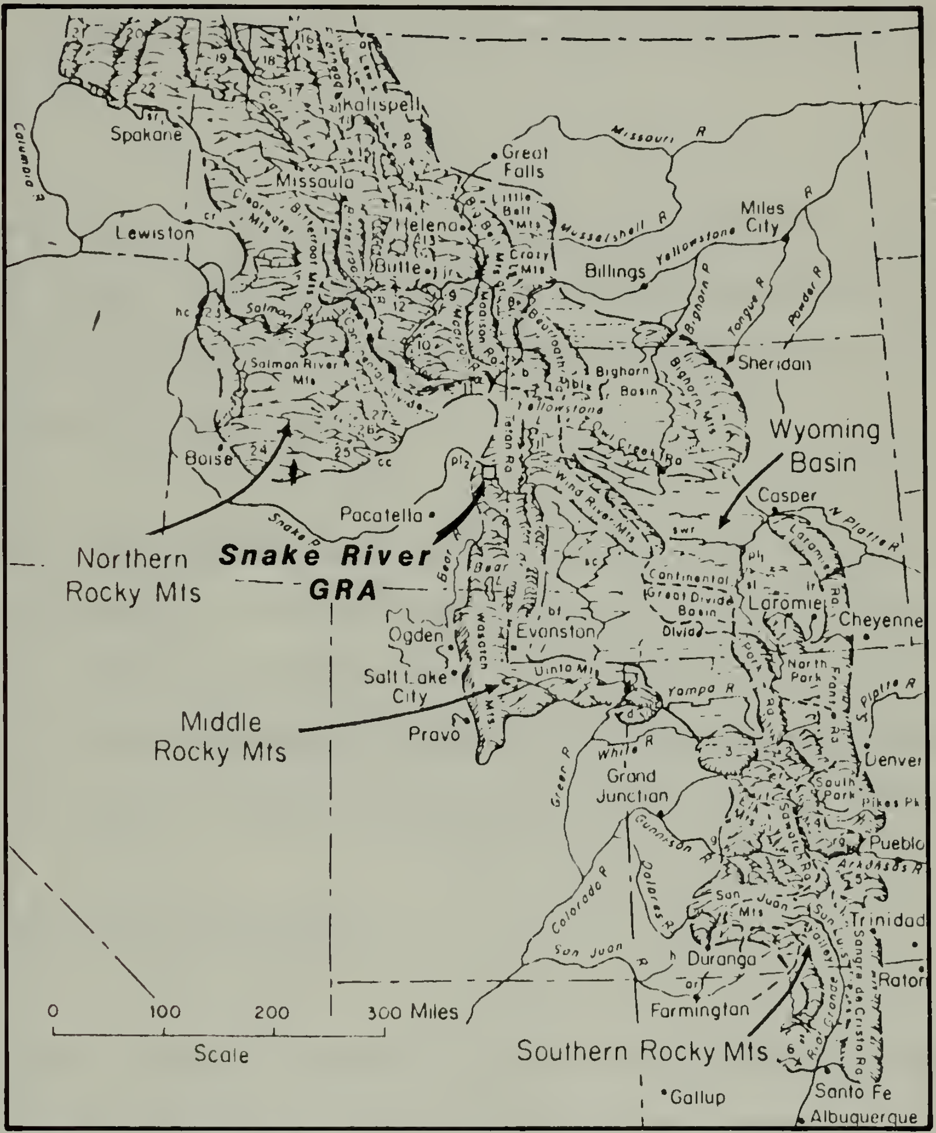
FIGURE 4



Map from Hunt (1974).

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REGION 2 NORTHERN ROCKY MOUNTAINS

Snake River GRA, Idaho

Regional Physiographic Setting

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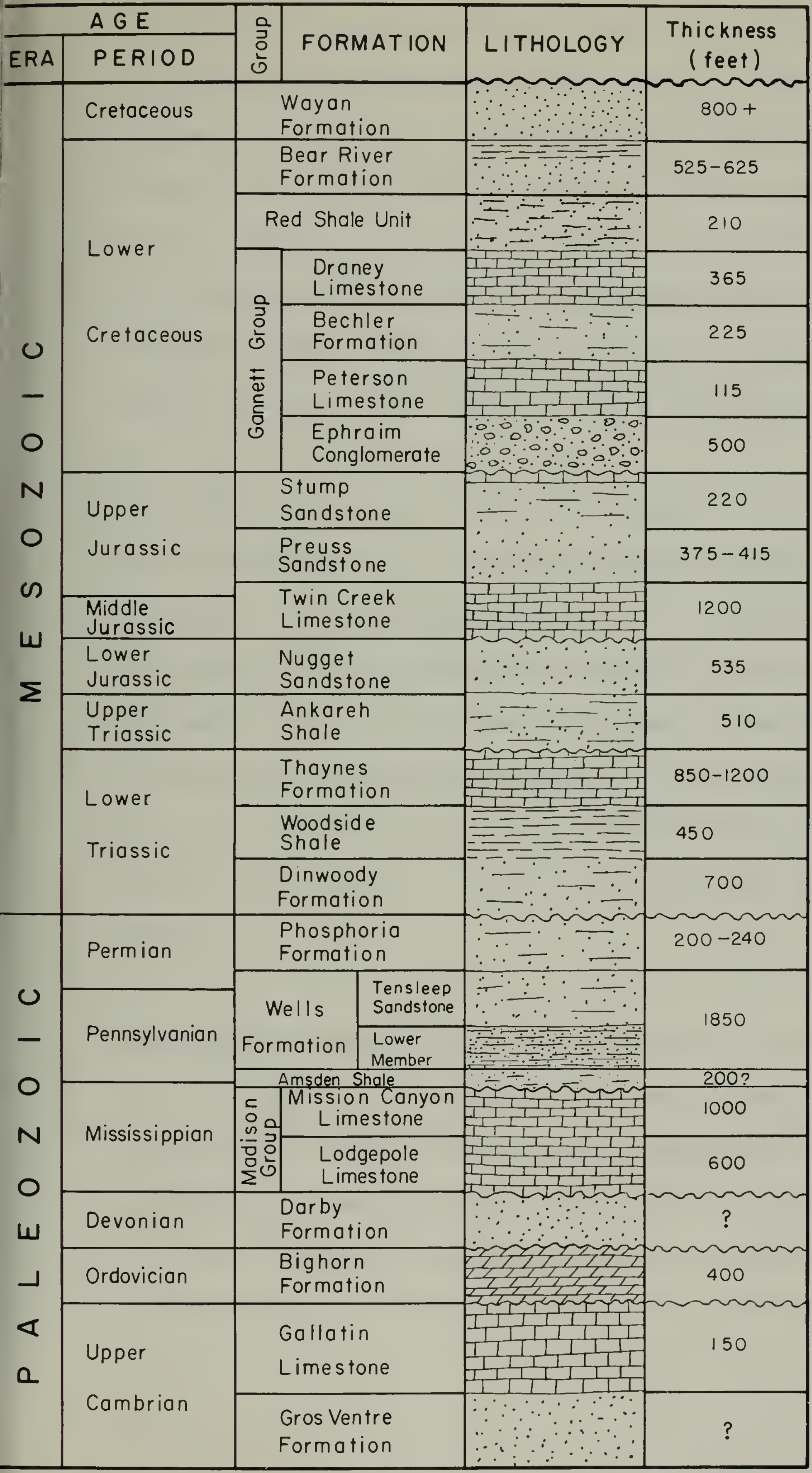
contains the northwest-flowing Snake River. The valley is four to six miles wide with an average elevation of 5,500 feet. It is bounded on the northeast by the Big Hole Mountains and on the southwest by the Caribou Range. The highest topographic feature in the GRA is Stouts Mountain with an elevation of 8,616 feet.

The Snake River and its tributary drainage systems display a good trellis drainage pattern. Major tributaries include the southwesterly-flowing Rainey, Pine and Burns Canyon Creeks and northeasterly-flowing Fall, Pritchard and Antelope Creeks.

Mean annual precipitation is 16 to 21 inches; the area generally receives between 100 and 120 inches of snowfall per year. Flora include sagebrush, buchbrush, greasewood, various poplars and at higher, wetter elevations, Douglas fir and Lodgepole pine. Average minimum and maximum temperatures are 8°F in January and 84°F in July, respectively (Savage, 1961).

2.3 Description of Rock Units

Savage (1961) reported a maximum of 9,800 feet of Paleozoic, 18,250 feet of Mesozoic and 1,000 feet of Tertiary strata in the vicinity of the Snake River GRA (Fig. 6). The thick Paleozoic and Mesozoic rock types are dolostones, limestones, sandstones, shales, and mudstones of shelf and miogeoclinal origin. Non-marine Tertiary conglomerates and volcanics overlie the older strata in some areas but are not continuous throughout the area. Mitchell and Bennett (1979) compiled the regional geology at a 1:250,000 scale. Modern stratigraphic names applied in the area are



ERA	PERIOD	Group	FORMATION		Thickness (feet)
MESOZOIC	Cretaceous		Wayan Formation		800 +
	Lower Cretaceous		Bear River Formation		525–625
			Red Shale Unit		210
		Gannett Group	Draney Limestone		365
			Bechler Formation		225
			Peterson Limestone		115
			Ephraim Conglomerate		500
	Upper Jurassic		Stump Sandstone		220
			Preuss Sandstone		375–415
	Middle Jurassic		Twin Creek Limestone		1200
	Lower Jurassic		Nugget Sandstone		535
	Upper Triassic		Ankareh Shale		510
	Lower Triassic		Thaynes Formation		850–1200
			Woodside Shale		450
			Dinwoody Formation		700
PALEOZOIC	Permian		Phosphoria Formation		200 –240
	Pennsylvanian		Wells Formation	Tensleep Sandstone	1850
				Lower Member	
			Amsden Shale		200?
	Mississippian	Madison Group	Mission Canyon Limestone		1000
			Lodgepole Limestone		600
	Devonian		Darby Formation		?
	Ordovician		Bighorn Formation		400
	Upper Cambrian		Gallatin Limestone		150
			Gros Ventre Formation		?

From: Savage (1961), Jobin and Schroeder (1964). Skipp et al. (1979)

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Snake River GRA, Idaho

Stratigraphic Column

SCALE			FIGURE
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catalogued by Pattison (1977) and Olson (1977). Many of the stratigraphic units have been discussed in regional summary studies of specific geologic intervals (Oaks et al., 1977; Loucks, 1977; Rose, 1977; several papers in Stewart et al., 1977; several papers in Fouch and Magathan, 1980; Kummell, 1954). Peterson (1977) constructed the palinspastic regional patterns along the Rocky Mountain shelf and in the miogeocline of the Great Basin for each Paleozoic period. Most of the following lithologic descriptions are summarized from Savage (1961) and Jobin and Schroeder (1964).

The oldest rocks exposed within the Snake River GRA are those of the Late Cambrian (515-500 m.y.) Gros Ventre Formation and the overlying Gallatin Limestone. The Gros Ventre Formation, an interbedded sequence of limestone, calcareous siltstone, calcareous shale and intraformational breccia, is exposed in only a few outcrops in the Snake River GRA. However, the Gros Ventre probably occurs more extensively in the subsurface. The Gallatin is a marine, bluish to brownish-gray, limestone with silty portions and thin beds of chert nodules. Thickness of the Gallatin is about 150 feet (Savage, 1961).

The Ordovician (560-435 m.y.) Bighorn Dolomite unconformably overlies the Gallatin Limestone. The Bighorn is a marine, coarse- to fine-grained light cream to buff rock with a few lenses and masses of chert. Fossils of crinoids, horn and honey comb corals have led some workers to assign a Silurian (435-395 m.y.) age to the Bighorn and correlate it with the Laketown Dolomite. Thickness is about 400 feet (Savage, 1961).

The Devonian (395-345 m.y.) Darby Formation unconformably overlies the Bighorn Dolomite. The Darby is composed of calcareous siltstone and sandstone with lesser fine-grained limestone and dolomite. The unit generally is dominantly calcareous in the lower part grading upward into a dominantly clastic section. On the basis of similar lithological transitions it is correlated with the Three Forks Shale. The Darby has a distinct petroliferous odor (Savage, 1961).

The Madison Group consisting of the basal Lodgepole Limestone and the overlying Mission Canyon Limestone unconformably overlies the Darby Formation. Foraminifers, corals, and brachiopods have all been used to date the Madison as Mississippian (345-310 m.y.). The Lodgepole Limestone is a dark gray, thin-bedded, fine-grained, marine limestone. Data on the thickness of the Lodgepole in the Snake River GRA is not available, but it is about 600 feet thick in nearby areas (Skipp et al., 1979). The Mission Canyon Limestone is a light gray weathering, massive- to thick-bedded, medium- to fine-grained limestone with a few cherty dolomites and limestone breccias in the upper part. The thickness of the Mission Canyon exceeds 1,000 feet (Jobin and Schroeder, 1964). The Mission Canyon represents a westward-prograding shelf-carbonate environment (Sando, 1977).

South of the Snake River Plain, the Madison is overlain by a sequence of quartzite, variegated shale, limestone, sandstone, siltstone, and shale which has been assigned variously to the basal part of the Wells Formation, the Big Snowy Formation, or the lower part of the Amsden Formation. All of these sequences are less than 200 feet and compose the western extension of lagoonal and restricted marine facies of the cratonic platform of Wyoming. Faunas consisting of foraminifers, bryozoans, brachiopods, ostracodes,

gastropods, and corals indicate a Late Mississippian (332-310 m.y.) to Early Pennsylvanian (310-305 m.y.) age for these rocks; therefore they are assigned to the Amsden Shale (Skipp et al., 1979).

The Pennsylvanian (310-280 m.y.) to Permian (280-230 m.y.) Wells Formation overlies the Amsden. The Wells Formation is divided into a lower member and the overlying Tensleep Sandstone Member (Skipp et al., 1979; Savage, 1961). The lower member is a thin-bedded pink to buff sandstone, with lesser red to gray limestone and red shale. Fusulinids from the lower member in the Wooley Range date the unit as Middle Pennsylvanian (305-290 m.y.). The Tensleep is fine-grained, white to grayish-yellow sandstone and quartzitic sandstone with beds of siliceous dolomite and local bluish-white chert bands (Savage, 1961). Although several authors have proposed a Late Pennsylvanian (290-280 m.y.) hiatus in the Wells due to an absence of Late Pennsylvanian fauna, part of the unit is now correlated with a sandstone in central westernmost Wyoming belonging to the Tensleep Sandstone and containing Late Pennsylvanian fauna. Fusulinids collected 300 to 400 feet above the base of the Tensleep in the Wooley Range extend the age of the upper member into the Permian (Skipp et al., 1979). The Wells varies in thickness from 200 to 1,600 feet in the Snake River GRA (Savage, 1961).

The Permian Phosphoria Formation conformably overlies the Wells Formation. The Phosphoria consists of yellowish to greenish-gray or black marine mudstone, shale, and sandstone, with local intercalations of limestone, dolomite and chert. Commonly two units are present: (1) the basal recessive weathering Meade Peak Phosphatic Shale Member, and (2) the upper more resistant Rex Chert Member. The thickness of the unit is 175 to 240

feet (Savage, 1961; Jobin and Schroeder, 1964). The age of the Phosphoria is primarily determined by correlation with exposures elsewhere. The Phosphoria is mined for its phosphate content (Service, 1966) and also is a good hydrocarbon source rock (Powers, 1977).

The Early Triassic (230-225 m.y.) Dinwoody Formation unconformably overlies the Phosphoria Formation. It is comprised of light-brown or olive-drab to tan marine shale, siltstone and sandstone, silty limestone, dolomite, and calcareous sandstone. These beds interfinger with the Woodside Shale. Where completely exposed the unit is 550 to 750 feet thick but it may be missing in parts of the area (Jobin and Schroeder, 1964).

The Early Triassic Woodside Shale is a light to russet-brown siltstone and reddish shale which locally contains gray limestone beds. The Woodside unconformably overlies the Phosphoria Formation in places. It is 450 to 1,130 feet (Savage, 1961; Jobin and Schroeder, 1964).

The Early Triassic Thaynes Formation overlies the Woodside Shale. The Thaynes is mainly dull gray, thin- to medium-bedded, bioclastic, marine limestone with interbedded sandstone and siltstone. Most beds weather yellow-brown except basal beds which weather blackish-brown. In some areas the Thaynes can be separated into: (1) a lower limestone and shale, (2) a middle limestone and shale, and (3) an upper calcareous siltstone, red shale and limestone. The base of the Thaynes Limestone is characterized by the presence of abundant Meekoceras. The unit is 850 to 1,200 feet thick (Savage, 1961).

The Ankareh Shale of Late Triassic (215-195 m.y.) age unconformably overlies the Thaynes Formation. It is composed of orange to red calcareous shale, siltstone and sandstone. Plant fossil debris is present locally which suggests that the unit is a terrestrial deposit (Savage, 1961). The thickness of the formation is about 510 feet (Jobin and Schroeder, 1964).

The Early Jurassic (195-1976 m.y.) Nugget Sandstone conformably overlies the Ankareh Shale. It is composed of red-brown to orange cross-bedded, fine- to medium-grained quartzitic sandstone with some interbedded red shale in the lower part. The Nugget is about 535 feet thick and usually forms resistant low ridges (Jobin and Schroeder, 1964). Weathering produces blocks and slabs which form prominent talus slopes (Savage, 1961). Both oil and gas are produced from the Nugget Sandstone in southwest Wyoming and northeast Utah.

The Middle (176-158 m.y.) and Upper Jurassic (158-141 m.y.) Twin Creek Limestone unconformably overlies the Nugget Sandstone. The formation is predominantly dark-gray, thin-bedded, shaly limestone interbedded with sandy oolitic medium-bedded limestone. The shaly limestone weathers to finger-size light-gray splintery fragments. The upper 80 feet consists of oolitic cliff-forming limestone and the basal 50 to 70 feet is red to purple shale. Total thickness of the Twin Creek Limeston ranges from 970 to 1,350 feet (Jobin and Schroeder, 1964; Savage, 1961).

The Upper Jurassic Preuss Sandstone conformably overlies the Twin Creek Limestone. This formation is of variable lithology but consists dominantly of red and reddish-gray laminated thin-bedded calcareous siltstone and

calcareous sandstone. The unit grades into thicker bedded cliff-forming calcareous sandstone in the upper 100 feet (Jobin and Schroeder, 1964). Marine fossils are occasionally present and the Preuss may be, at least in part, lagoonal in origin. Thickness is 375 to 415 feet (Savage, 1961).

The Upper Jurassic Stump Sandstone conformably overlies the Presuss Sandstone. The formation consists of: (1) a basal gray-green platy medium- to fine-grained calcareous glauconitic sandstone about 50 feet thick, (2) a middle gray-green shale and calcareous siltstone about 55 feet thick, and an upper dominately gray-green thick- to irregularly-bedded fine-grained silty limestone about 110 feet thick (Jobin and Schroeder, 1964). Limestone beds are moderately fossiliferous (Savage, 1961).

The Early Cretaceous (141-100 m.y.) Gannett Group unconformably overlies the Stump Sandstone (Eyer, 1969). The overall thickness of the Group is about 1,200 feet in the Snake River GRA and it is separated into four conformable formations. These are (oldest to youngest): (1) the Ephraim Conglomerate, (2) the Peterson Limestone, (3) the Bechler Formation, and (4) the Draney Limestone. The Ephraim Conglomerate is a heterogeneous unit of interbedded lenticular earthy sandstone, siltstone, and mudstone with pebble conglomerate lenses. The rocks are dominately red but some beds are gray-green purple or brown. Conspicuous cross bedding is present in sandy units. Thickness is approximately 500 feet. The Peterson Limestone is predominately a dark to medium brownish-gray, sublithographic, medium-bedded limestone which weathers to light cream or white. Thickness is approximately 115 feet. The upper 25 feet is thinner bedded with abundant shaly limestone (Jobin and Schroeder, 1964). Holm et al. (1977) interpret the Peterson to

be a lacustrine limestone. The Bechler Formation is comprised of red shale, mudstone, and siltstone with scattered thin beds of fine-grained gray-green friable salt and pepper sandstones. Total thickness is approximately 225 feet. The Draney Limestone is mainly interbedded thin- to medium-bedded sublithographic limestone and shaly limestone. It is generally dark brownish-gray and has abundant calcite veining. The total thickness of Draney is approximately 365 feet (Jobin and Schroeder, 1964). Like the Peterson Limestone the Draney represents lacustrine sediments deposited in a foreland basin (Holm et al., 1977).

The Draney Limestone is conformably overlain by an unnamed unit comprised of red shale, mudstone, siltstone and thin interbedded greenish-gray salt and pepper sandstones. This unit is about 210 feet thick and is dated as Early Cretaceous (Jobin and Schroeder, 1964).

The Lower Cretaceous Bear River Formation conformably overlies the above unnamed unit. The Bear River Formation is of terrestrial fluvial origin and consists of two members: (1) a lower black to dark greenish-gray fissile shale and scattered dark gray rusty-weathering calcareous siltstone, and (2) an upper interbedded light yellowish-gray medium- to thick-bedded salt and pepper sandstone with subordinate light yellow to gray-green shale and mudstone. The sandstones in the upper member are fine-grained and cross-bedded. Thickness ranges from 175 to 225 for the lower member and from 350 to 400 feet for the upper member (Jobin and Schroeder, 1964). Carbonaceous shales of the Bear River Formation are uraniferous at Fall Creek in the southern part of the Snake River GRA (Vine, 1959).

The conformably overlying Wayan Formation of Lower(?) and Upper Cretaceous age consists of interbedded red and green variegated mudstone and thin beds of tan, fine-grained salt and pepper sandstone with subordinate impure limestone and black shale (Jobin nd Schroeder, 1964). Coal deposits are being mined in the Wayan Formation in Wyoming (Savage, 1961). The thickness of the formation is about 800 feet in the Snake River GRA where only the basal part of the unit is present (Jobin and Schroeder, 1964).

Tertiary units, which are in angular unconformity with the underlying Mesozoic rocks, include conglomerate, rhyolitic welded tuffs, basalt flows, loess, alluvium and colluvium and in places travertine deposits. Various workers have attempted to subdivide and correlate the Tertiary rocks into various stratigraphic units such as the Salt Lake Formation, Kirkhan Hollow Volcanics, and others. Most subdivisions and correlations have been unsuccessful and the geologic compilation shows considerable discrepencies. In general, however the Tertiary stratigraphy consists of a sequence of several hundred feet of Pliocene (6-2 m.y.) conglomerates filling the Swan Valley graben and younger Pliocene(?) to Quaternary(?) rhyolitic welded tuffs deposited in a widespread sheath over the northern end of the Caribou Range. The thickness of the tuffs is estimated at 200 feet. Unconformably overlying the rhyolitic welded tuffs are basalt flows and tuffs of Pliestocene (2-0.1 m.y.) age which temporarily dammed or otherwise disrupted flow of the Snake River. Some pillowed flows are present. These basaltic rocks are part of the Snake River Plain Volcanics (Savage, 1961).

Quaternary deposits of loess, alluvium, colluvium, and travertine comprise the youngest units. These are mapped by Scott (1981). Travertine deposits

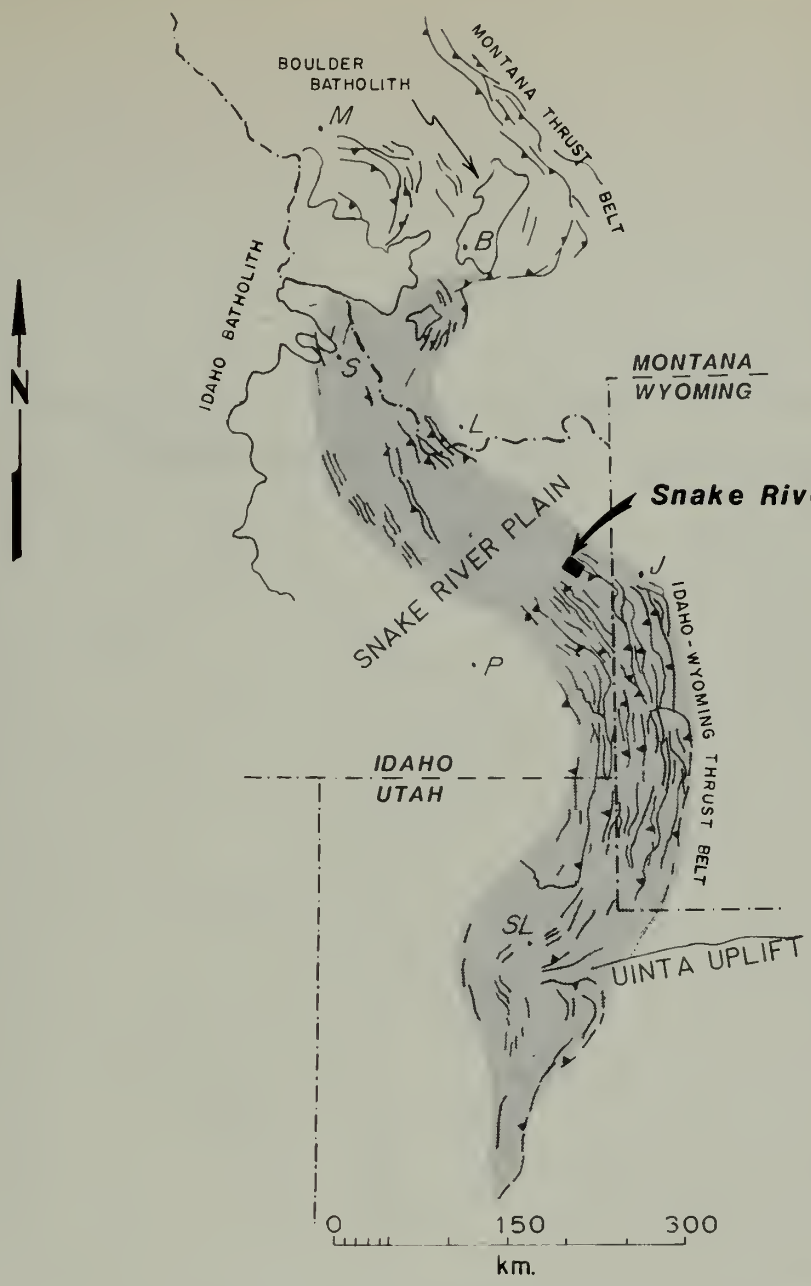
related to thermal springs which issue or have issued from faults along the Swan Valley graben occur intermittently along the edges of Swan Valley. The deposits consist of compact to vuggy calcium carbonate which have in some places been mined for decorative stone (Savage, 1961, 1969).

The three Wilderness Study Areas in the Snake River GRA are islands in the Snake River which are made up of recent alluvium. The alluvium consists of well-sorted silt, sand and gravel (Jobin and Schroeder, 1964).

2.4 Structural Geology and Tectonics

Southeastern Idaho is part of the Cordilleran Fold Belt which extends in a north-south direction from the Lewis and Clark transverse zone in Montana to the Texas lineament (King, 1969; Blackstone, 1977). Southeastern Idaho is also included in the "overthrust belt" which is characterized by major low angle, west dipping thrust faults; open to overturned folds; and younger normal faults (Mansfield, 1927; Blackstone, 1977). The tectonic history of the "overthrust belt" is summarized by Armstrong and Oriel (1965). The Snake River GRA is situated within the western portion of the Cordilleran Fold Belt. The GRA is within the Eastern Unit (Blackstone, 1977) segment of the frontal overthrust belt salient lying between east-central Utah and west-central Montana (Fig. 8). This frontal salient is defined by Beutner (1977) as the Sevier orogenic belt (Fig. 7).

The Eastern Unit (Fig. 8), as defined by Blackstone (1977), lies between the trace of the Jackson-Prospect-Hogsback (Darby) faults on the east and the



Structural trends in the frontal Sevier orogenic belt,(stippled) Utah-Montana. Principal folds trends shown by lines; teeth on major thrust faults. M=Missoula; B=Butte; S=Salmon; L=Lima; P=Pocatello; J=Jackson; SL=Salt Lake City.

Data by: Beutner (1977)

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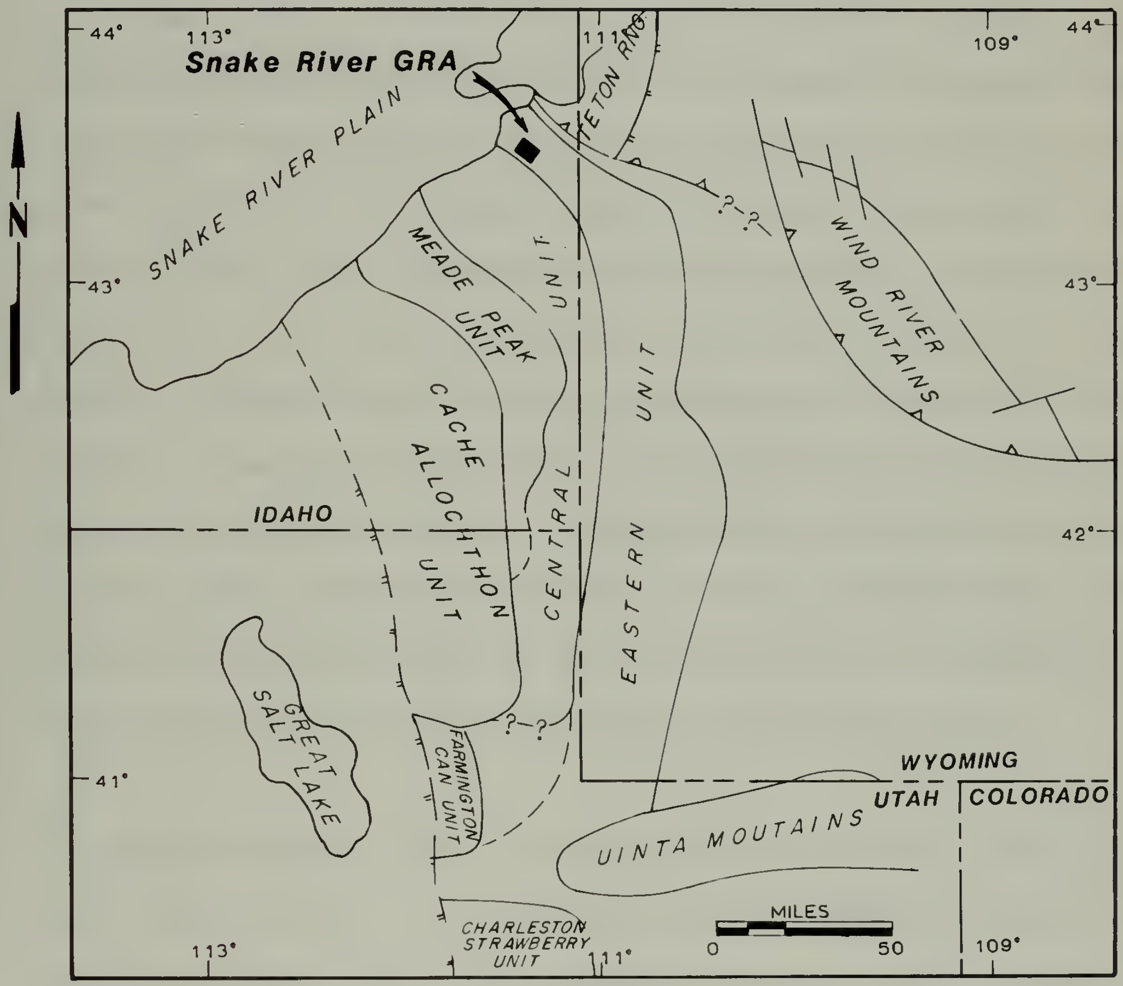
Snake River GRA, Idaho

Regional Geologic Setting

SCALE AS SHOWN
DATA BY
DATE 1/1983
DRWN BY DSI
APPR. GF
REV. SEC.
FIGURE 7



DATA BY: BLACKSTONE, (1977)

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Snake River GRA, Idaho

Regional Structural Setting

SCALE AS SHOWN
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APPRVD G F
REV SEC
FIGURE 8

trace of the Baldy Mountain-Tunp-Medicine Butte thrust faults on the west. The northeastern edge of the unit is bounded by the Jackson thrust which merges with the Prospect thrust. On the south side of Snider Basin, the boundary swings eastward following the Hogsback (Darby) thrust. The Hogsback (Darby) thrust trends south after passing along the east side of Hogsback Ridge. Thus, the Eastern Unit is arcuate in shape, convex to the east. The western margin of the Eastern Unit is a compound one beginning with the major normal fault along the east side of the Star Valley-Swan Valley depression and continuing south along the Tunp and Medicine Butte thrust faults. Faults within the Eastern Unit have remarkable persistence and continuity. The trace of the Absaroha fault is continuous for a distance of 200 miles and maintains a consistent stratigraphic separation for long distances. The fault surfaces dip gently westward at 15 to 20 degrees. All faults flatten toward the west. Cambrian strata involved in the hangingwall of these faults indicate that the fault surfaces are essentially parallel to the bedding surface and that the faults are rooted in a decollement at the approximate level of the Gros Ventre Shale (Blackstone, 1977).

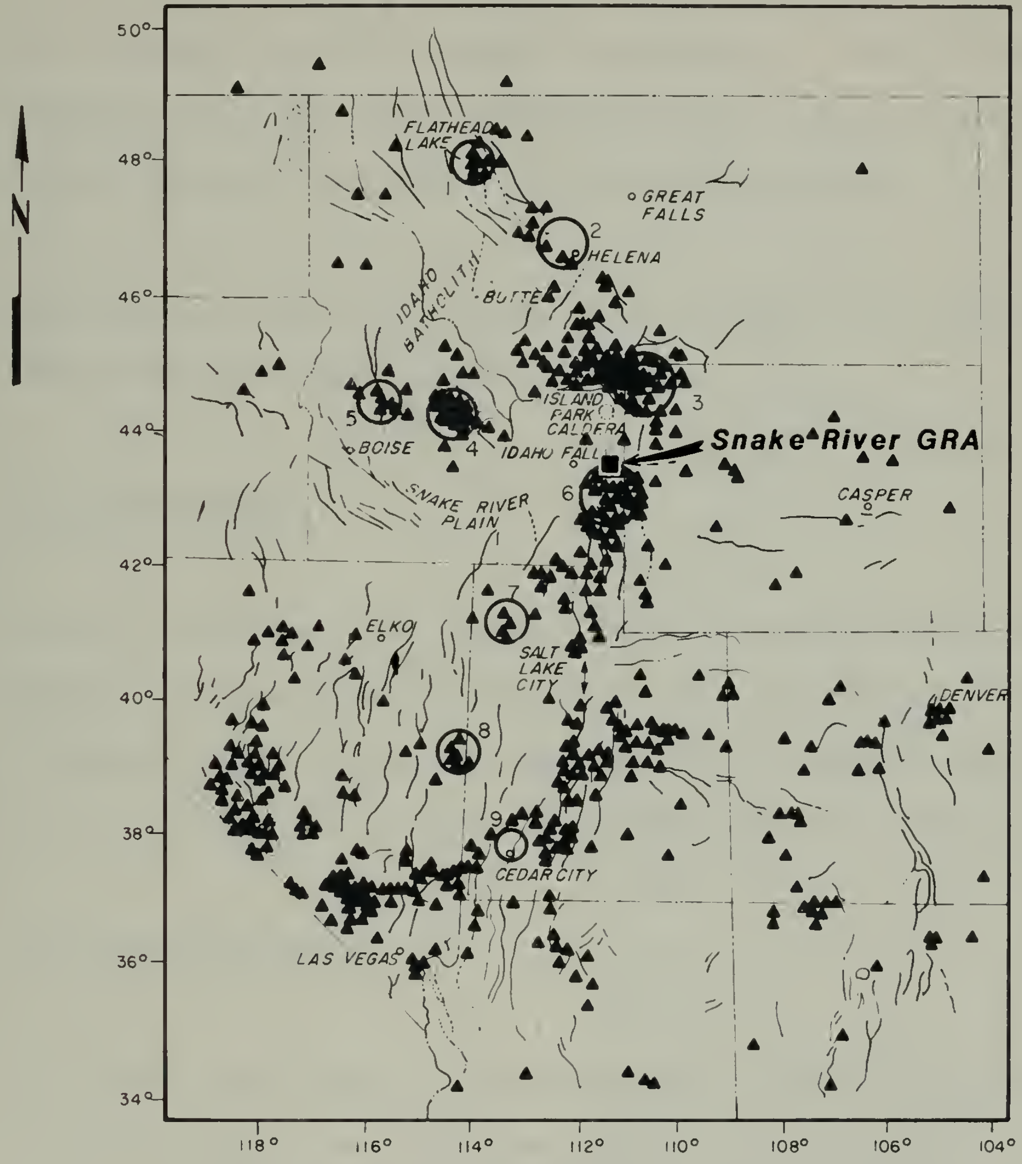
The general effect of tectonic movement within the central part of the Sevier orogenic belt is to bring older rocks to a higher structural position, to move younger rocks eastward from their sites of deposition, and in a regional sense place younger rocks over older rocks. In particular, post-Cambrian sedimentary strata have been shifted eastward over the older crystalline basement. The usual emplacement of older rocks on younger ones takes place at the toe of all major thrust sheets in the Sevier belt. Within the Eastern Unit, Cambrian to Devonian age strata are in fault contact with strata of Late Cretaceous age along the Asaroha fault and

Cambrian strata occur in the hangingwall and Paleocene strata in the footwall along the Hogsback (Darby) fault (Blackstone, 1977).

Thrusting in the Sevier orogenic belt appears to have originated with movement of the Cache Allochthon as indicated by the thick (over 5,000 feet) synorogenetic conglomerate present in the basal Ephraim Formation within the Red Mountain Syncline. These conglomerates thicken toward the westerly source. Deformation of the thrust belt shifted eastward with time. Stratal shortening in the central part of the salient is 50 percent or 50 to 60 miles of total tectonic transport (Blackstone, 1977).

Within the Snake River GRA the predominant structural trend is northwest-southeast. Major faults include the Snake River fault (Jobin and Schroeder, 1964) and the Swan Valley-Star Valley fault, both northwest-trending normal faults which define the graben underlying Swan Valley (Savage, 1961). This graben is post-thrusting and is probably an eastward extension of basin-and- range faulting (Blackstone, 1977). Northeast of Swan Valley are a number of thrust faults including the Absaroka. Southwest of Swan Valley the style of deformation includes long linear folds associated with thrust faulting. The younger faults in the area are normal faults, some of which are still active.

The Snake River GRA lies within a seismically active area known as the Intermountain Seismic Belt (Fig. 9) a north-trending zone of seismicity in the western United States which closely follows the boundary between the Great Basin and the Colorado Plateau-Middle Rocky Mountains (Smith and Sbar,



EPICENTERS FOR INTERMOUNTAIN SIESMIC BELT SHOWING ALL EARTHQUAKES REPORTED BY NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) OF ABOUT MAGNITUDE 3.0 OR GREATER FROM 1961 THROUGH 1970. DOUBLE ARROW SHOWS ZONE OF LOW SIESMICITY. CIRCLES MARK EARTHQUAKE SWARMS 1, FLATHEAD LAKE, MONT. 2, HELENA, MONT. 3, YELLOWSTONE PARK. 4, SAWTOOTH RANGE, IDAHO 5, IDAHO BATHOLITH 6, CARIBOU RANGE, IDAHO 7, GREAT SALT LAKE DESERT, UTAH 8, LEHMAN CAVE MONUMENT, NEVADA 9, CEDAR CITY, UTAH

DATA FROM SMITH AND SBAR (1974)

0 70 140 210 MILES
SCALE APPROXIMATE

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Snake River GRA, Idaho

Regional Seismicity

SCALE AS SHOWN
DATA BY
DATE 1/1983
REVISED
DRAWN BY DSI
APPR. GF
FIGURE 9

1974). The seismic activity is characterized by shallow focal depths and results from an east-west extensional tectonic regimen (Smith, 1978). The Caribou Range including the GRA is a locus of earthquake swarms. Thus, the major geologic hazard in the GRA is earthquakes. The most significant historic earthquake in the Intermountain Seismic Belt was the 1959 Hebgen Lake earthquake of magnitude 7.1 (Smith and Sbar, 1974).

The WSAs are islands in the Snake River; therefore, they are also subject to the geologic hazard of flooding.

2.5 Paleontology

Fossils are present, and locally abundant, throughout the Paleozoic and Mesozoic section present in the Snake River GRA. However, no particular noteworthy fossil locales are reported within the Snake River GRA. Table I lists fossils present in some of the formations found within the GRA.

2.6 Historical Geology

The depositional history of the area begins at 850 million years ago as late Precambrian strata were deposited in an epicratonic trough or troughs from cratonic sources to the east. This was followed by formation of an extensive outer cratonic platform or miogeosyncline which developed along the entire length of the cratonic margin. A thick sequence of sediments accumulated in this miogeosyncline (Blackstone, 1977).

The miogeosyncline existed as a site of deposition throughout lower Paleozoic time and deposition was continuous in places from Late Precambrian

TABLE I

FOSSILS PRESENT IN VARIOUS FORMATIONS
IN THE SNAKE RIVER GRA

Formation	Fossils
Gros Venture	various trilobites
Bighorn Dolomite	crinoids, corals
Lodgepole	*Syringopora* sp. *Loxonema* sp. *Productella* sp. *Spirifer centronatus* *Chonetes* sp. *Euomphalus* sp.
Mission Canyon	*Syringopora* *Lithostrotion* *Martinia* *Productus giganteus*
Wells Formation	*Spirifer occidentalis* *Spirifer rockymontanus* *Schizophoria* sp. *Marginifera* sp. *Composita* sp. *Squamularia* sp. *Productus* sp.
Phosphoria Formation	*Chonetes ostiolatus* *Productus* sp. *Pugnax weeksi* *P. weeksi var. nobilis* *Gatrioceras simulator* *Lingulidiscina missouriensis* *Ambocoelia arcuata* *Omphalotrochus ferrieri* *O. conoideus* *Nucula montpelierensis* *Yoldia mcchesneyana* *Grammysia(?) carbonaria*
Thaynes	*Meekoceras* sp.

TABLE I (Cont.)

FOSSILS PRESENT IN VARIOUS FORMATIONS

IN THE SNAKE RIVER GRA

Twin Creek Limestone	*Pentacrinus asteriscus*
	Camptonectes pertenuistriatus
	Trigonia americana
	Astarte meeki
	Thracia weedi
	Gryphaea calceola
	Ostrea sp.
	Pholadomya sp.
	Pleuromya sp.
Stump Sandstone	*Gryphea nebraskensis*
	Pentacrinus asteriscus
	Belemnites sp.
	Ostrea strigilecula
	"Rhynchonella"
	Camptonectes sp.
	Astarte sp.
	Trigonia
Bear River Formation	*Pyrqulifera humerosa*
	Campeloma macrospira
	Corbula pyriformis
	Corbicula durkeei
	Unio sp.
	Viviparus sp.
	Goniobasis sp.
	Pachymelania sp.

into Early Cambrian time. In southeastern Idaho approximately 35,000 feet of Paleozoic strata, principally carbonates accumulated in the miogeosyncline by the end of the Permian time. The Paleozoic units in the trough are generally continuous with equivalent age rocks on the shelf to the east with the exception of Early Cambrian rocks. The Early Cambrian formations wedge out at the hinge line of the trough, near what is now the Idaho-Wyoming border. During lower Mesozoic time the site of deposition in the miogeosynclinal trough was about the same as earlier (Blackstone, 1977).

The site of major deposition began to shift eastward during the Triassic since the thickest sections of Triassic rocks were deposited slightly east of the sites of maximum Paleozoic accumulation. Orogenic uplift associated with the Sevier orogenic event in northeast Nevada and northwestern Utah accelerated this eastward shift. The depositional pattern changed drastically by Jurassic time as the major site of deposition continued its eastward shift during Jurassic and Cretaceous time when thick locally coarse clastics were deposited in what is now the eastern part of the Sevier orogenic belt (Blackstone, 1977). These sediments are believed to be the source rocks for several of the oil and gas deposits within the "overthrust belt" (Powers, 1977).

The result of deposition beginning about 850 million years ago and ending in the Cretaceous was the formation of a wedge-shaped prism of sediments on a basement complex 1.6 billion years old or older. The western edge of the miogeosynclinal prism was as much as 60,000 feet thick while total thickness along the hinge line was about 12,000 feet. This prism varied in thickness

along strike. Parameters which were to influence the localization of thrust faults during later deformation include variation within the sedimentary prism (i.e. limestone versus shale); the surface configuration of the older Precambrian basement, the extent and volume of sediments; and the distribution of fluid pressures (Blackstone, 1977).

Deformation of the miogeosynclinal prism was initiated during the Sevier orogeny which began by latest Jurassic time (Royce et al., 1975; Beutner, 1977). The first thrust plate in the frontal Sevier orogenic belt to be activated was the Cache allochton as indicated by the deposition of thick synorogenic conglomerates belonging to the Ephriam Formation of Late Jurassic and Early Cretaceous age (Armstrong and Oriel, 1965). Deformation shifted eastward with time progressively involving the Meade Peak, Central, and Eastern Units as older thrust faults "piggy-backed" on the youngest (Paleocene) thrusts (Blackstone, 1977).

Basin-and-range block faulting, a manifestation of an extensional tectonic regimen, was initiated in the mid-Tertiary and has continued to the Holocene. Graben structures (such as Swan Valley) formed deep basins as a result of the normal faulting. Subsequently these basins were filled with thick accumulations of Tertiary sediments (Blackstone, 1977).

By the Pliocene volcanic activity associated with development of the eastern Snake River Plain became widespread producing deposits of ash and lava flows (Armstrong, 1978). The area continues to be one of the high heat flow giving rise to thermal springs such as those found near Fall Creek (Mitchell et al., 1980).

3.0 ENERGY AND MINERAL RESOURCES

3.1 Introduction

Data on the mineral and energy resources of the Snake River GRA was compiled from all available sources. These included the U.S. Bureau of Mines MILS File, the U.S. Geological Survey CRIB file and compilations by Mitchell et al. (1981). The report on the geology and mineral resources of Bonneville County (Savage, 1961) covers most of the GRA and is a particularly valuable source of data. Other information was taken from more specific reports by Savage (1969), Jobin and Schroeder (1964), Asher (1965), Breckenridge (1982), Mitchell et al. (1980), Service (1961), Vine and Moore (1952), and Vine (1959).

3.2 Known Mineral and Energy Deposits

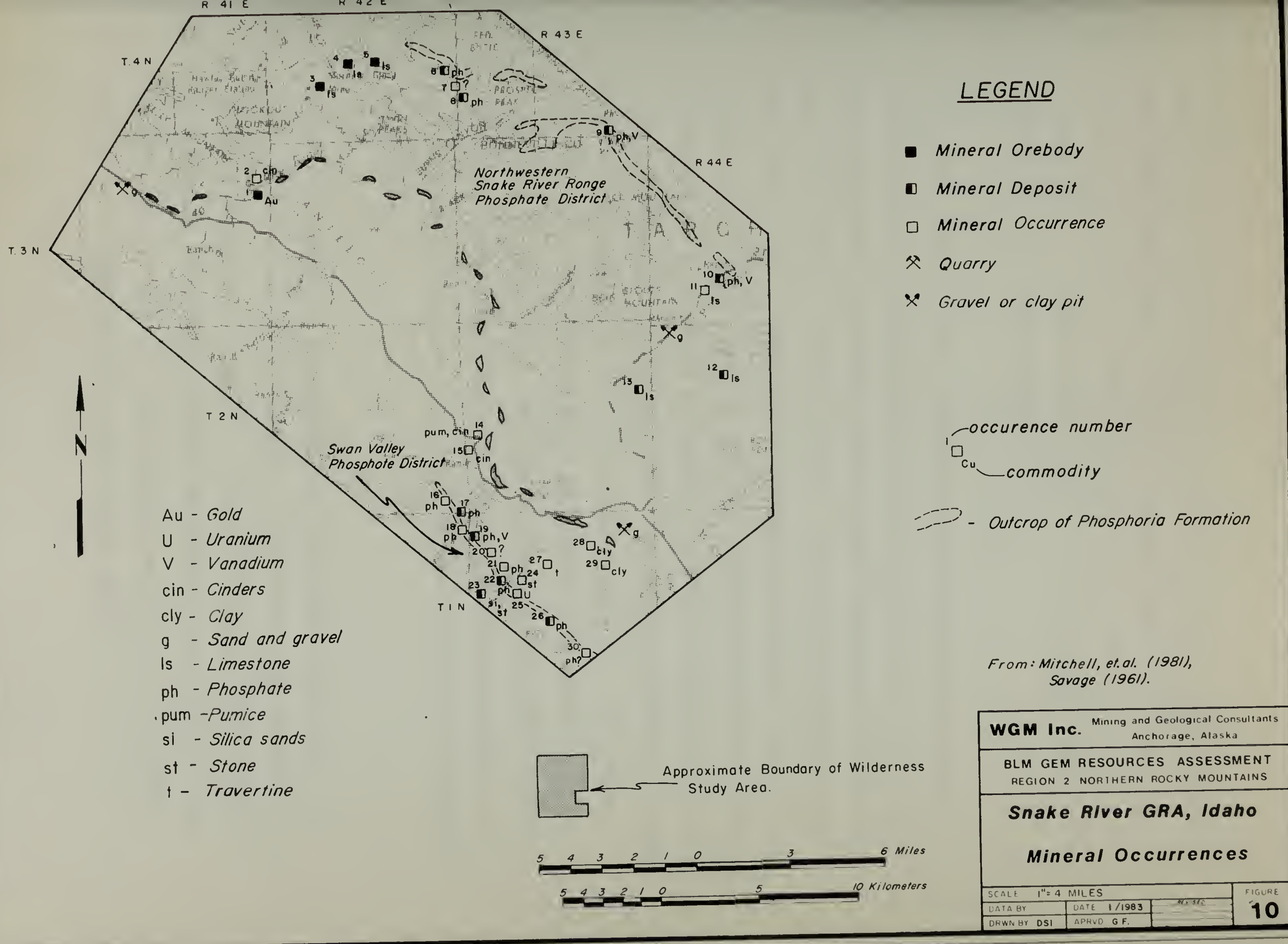
A gravel bar near Heise (loc. 1, Fig. 10, Table II), where placer gold was mined during the 1950s, is the only known metallic mineral deposit in the Snake River GRA. This occurrence, the Roy Coles gold placer, is described by Savage (1961, p. 79) as follows:

> "An area that has been worked in recent years, about 7.5 to 8 miles upstream from Heise along the south bank of Snake River, is representative of the Snake River placers. This deposit, called the Roy Coles property, encompasses about 160 acres and reportedly yields around $5 worth of gold per cubic yard. Similar lean placers generally yield less -- for example, around 25 cents to $1 per cubic yard of placered gravel. Pay streaks are very irregular and gold values per cubic yard of gravel fluctuate widely within any one placer."

TABLE II

MINERAL DEPOSITS, PROSPECTS AND OCCURRENCES IN THE SNAKE RIVER GRA, IDAHO

Map No.	Name	Commodity	Reference
1	Roy Coles placer	Gold	Savage (1961)
2	Unnamed	Cinder	Mitchell et al. (1981)
3	Morning Glory mine	Limestone	Savage (1969)
4	Unnamed	Limestone	Mitchell et al. (1981)
5	Limekiln Canyon mine	Limestone	Savage (1969)
6	Grover, Grover and Terry	Phosphate,	Staatz and Albee (1966)
7	Unnamed	?	Mitchell et al. (1981)
8	Coalmine Creek	Phosphate	Staatz and Albee (1966)
9	Piney Peak	Phosphate, Vanadium	Staatz and Albee (1966)
10	Pine Creek	Phosphate, Vanadium	Staatz and Albee (1966)
11	Unnamed	Limestone	Savage (1961)
12	Dry Fork	Limestone	Mitchell et al. (1981)
13	Pine Creek	Limestone	Mitchell et al. (1981)
14	Conant Valley	Pumice, Cinder	Savage (1969)
15	Garden Creek	Cinder	Mitchell et al. (1981)
16	Garden Creek	Phosphate	Mitchell et al. (1981)
17	Pritchard Creek	Phosphate	Jobin and Schroeder (1964)
18	Swan Valley	Phosphate	Mitchell et al. (1981)
19	Pritchard Creek	Phosphate	Jobin and Schroeder (1964)
20	Unnamed	?	Mitchell et al. (1981)
21	Unnamed	Phosphate	Savage (1961)
22	Fall Creek	Phosphate	Jobin and Schroeder (1964)
23	Fall Creek	Silica, Quartzite	Mitchell et al. (1981)
24	Mineral Springs	Stone	Mitchell et al. (1981)
25	Joseph Smith mine (God Send to Health mine)	Coal, Uranium	Vine (1959); Savage (1961)
26	Papoose Creek	Phosphate	Mitchell et al. (1981)
27	Fall Creek	Travertine	Mitchell et al. (1981)
28	Unnamed	Bentonite	Savage (1961)
29	Unnamed	Clay	Mitchell et al. (1981)
30	Unnamed	Phosphate?	Mitchell et al. (1981)



From: Mitchell, et.al. (1981), Savage (1961).

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Snake River GRA, Idaho

Mineral Occurrences

SCALE 1" = 4 MILES		FIGURE
DATA BY	DATE 1/1983	10
DRWN BY DSI	APRVD G.F.	

Savage gives no production data for the Roy Coles Placer. Staley (1945) reports that 2,864 ounces of gold were produced from the Snake River in Bonneville County prior to 1945. The production was from three areas: (1) Idaho Falls, (2) McCoy Creek and (3) Heise (the Roy Coles placer). No information is available on reserves.

In the Snake River GRA, both the Mission Canyon Limestone and the Wells Formation contain relatively pure limestones (Jobin and Schroeder, 1964). Past production has come from the Mission Canyon limestone in the northern part of the GRA (loc. 3-5, Fig. 10, Table II) and in the Pine Creek area (loc. 11-13, Fig. 10, Table II). At locality 3, the Morning Glory mine, an old shaft has been sunk to about 40 feet in medium hard marble-like calcite. To the west two older shafts are present. Up the hill from the shafts the bedrock is light gray to gray limestone. Two analyses of samples collected here indicate that the rock is high in calcium carbonate. The samples contained 95.7 to 96.1 percent $CaCO_3$ and 1.1 to 0.6 percent $MgCO_3$, respectively (Savage, 1969). Not much is known about the other localities except that Savage (1961) reported that an old lime kiln was present in one of the canyons southeast of Pine Creek. No past production or reserve data are known.

Travertine deposits are associated with springs which occur between the mouths of Fall Creek and Garden Creek. These deposits are localized along the trace of the Snake River fault (Jobin and Schroeder, 1964). Although these deposits ahve not been worked, the travertine has a high calcium content and is suitable for lime production as shown by the following analysis of a sample from Fall Creek (Savage, 1961):

SiO_2	Al_2O_3	Fe_2O_3	$CaCO_3$	$MgCO_3$	Insoluble Residue
0.0	0.0	0.0	99.8	0.0	0.2

The above sample was from locality 27 (Fig. 10, Table II). The reserves of travertine at Fall Creek are limited (Jobin and Schroeder, 1964).

A thermal spring at the mouth of Fall Creek (loc. 2, Fig. 11, Table III) is the only known deposit of any energy resource in the Snake River GRA. The spring has a surface temperature of 25°C, a flow of 264 l/min. and an estimated aquifer temperature of 42°C (Mitchell et al., 1980). The spring is along the Heise-Alpine trend, a major linear feature in southeastern Idaho which appears to control the distribution of thermal springs (Day, 1974; Haskett, 1976).

There are two phosphate districts in the Snake River GRA: (1) the Snake River Range district, and (2) the Swan Valley district (Gere, 1964). These districts have been mapped and sampled by the U.S. Geological Survey and U.S. Bureau of Mines. The results of this work are summarized by Service (1966) and Coffman and Service (1967) and estimated phosphate resources are shown in Table IV. The Snake River Range district extends from Pine Creek northwestward to Limekiln Canyon (Fig. 12). The Phosphoria Formation is exposed almost continuously along the crest of the Snake River Range but is offset locally by high angle faults deformed by folds (Coffman and Service, 1967). Most of the eastern part of the district is covered by phosphate leases (Fig. 15). The Swan Valley phosphate district extends from Bear Creek northwestward to several miles past Pritchard Creek (Fig. 13). The

TABLE III

SUMMARY OF NON-METALLIC ENERGY RESOURCES IN THE SNAKE RIVER GRA, IDAHO

OIL AND GAS WELLS

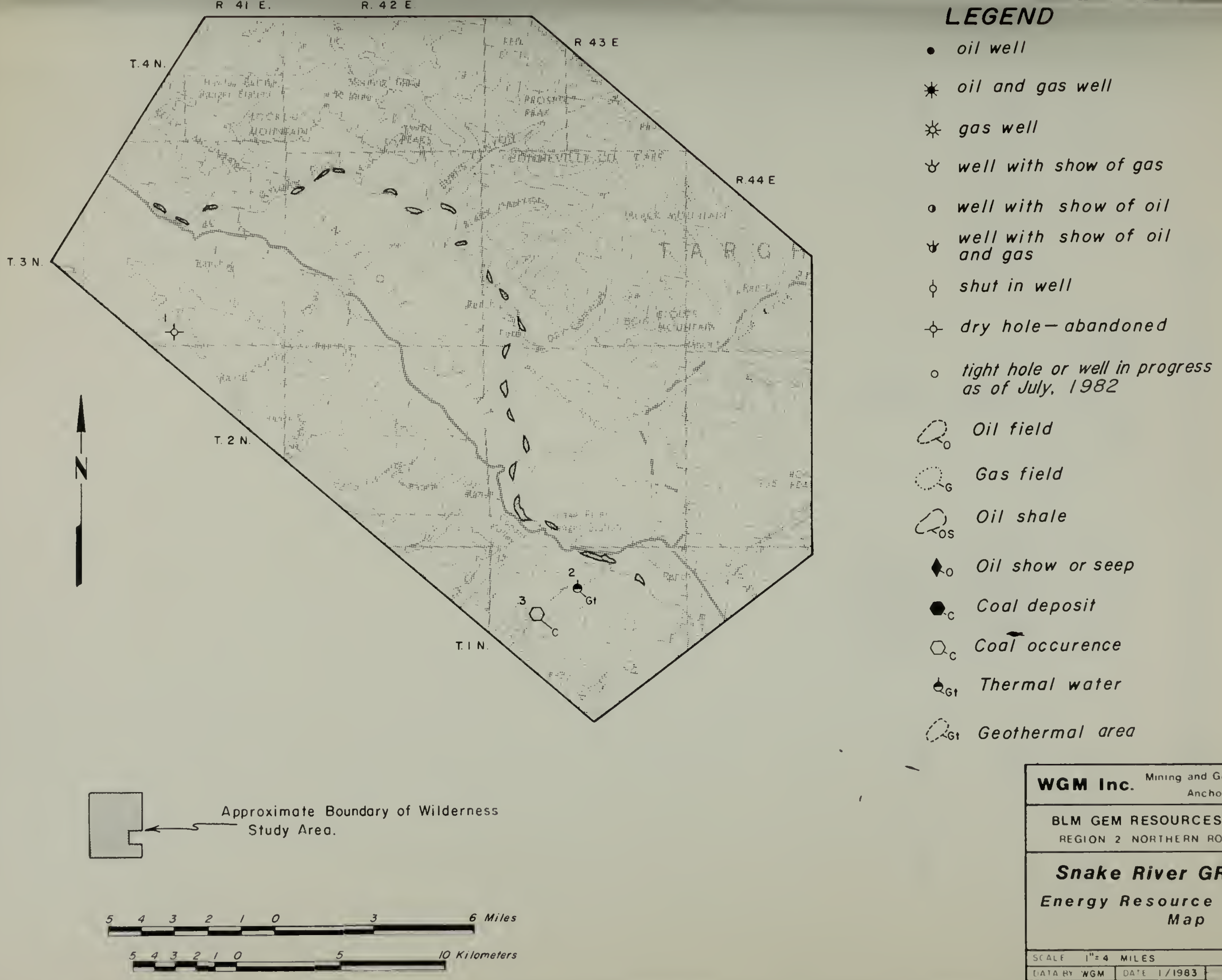
Map	Location					Year			Status
No.	Sec.	T.	R.	Well	Company	Drilled	Depth (ft.)	Production	(Aug. 1982)
1	33	3N	41E	Meadow Creek-Sorenson No. 1	The California Oil Company	1928-30	3,774	None	Abandoned

THERMAL SPRINGS

Map		Location						
No.	Name	Sec.	T.	R.	Measured Temp (°C)	Discharge (l/min.)	Total Dissolved Solids (TDS)	Source of Data
2	Fall Creek Spring	9	1N	43E	25	265	4,658	Young and Mitchell (1973)

COAL

Map		Location					
No.	Name	Sec.	T.	R.	Heat Value	Description	Source of Data
3	Joseph Smith (God Send to Health) mine	8	1N	43E	3,000 Btu	Coaly beds in Bear River Formation located on tightly folded anticline	Vine (1959); Savage (1961); and Kilsgaard (1964)



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REGION 2 NORTHERN ROCKY MOUNTAINS

Snake River GRA, Idaho
Energy Resource Occurrence Map

SCALE 1" = 4 MILES			FIGURE
DATA BY WGM	DATE 1/1983		11
DRWN BY DSI	APRVD G F		

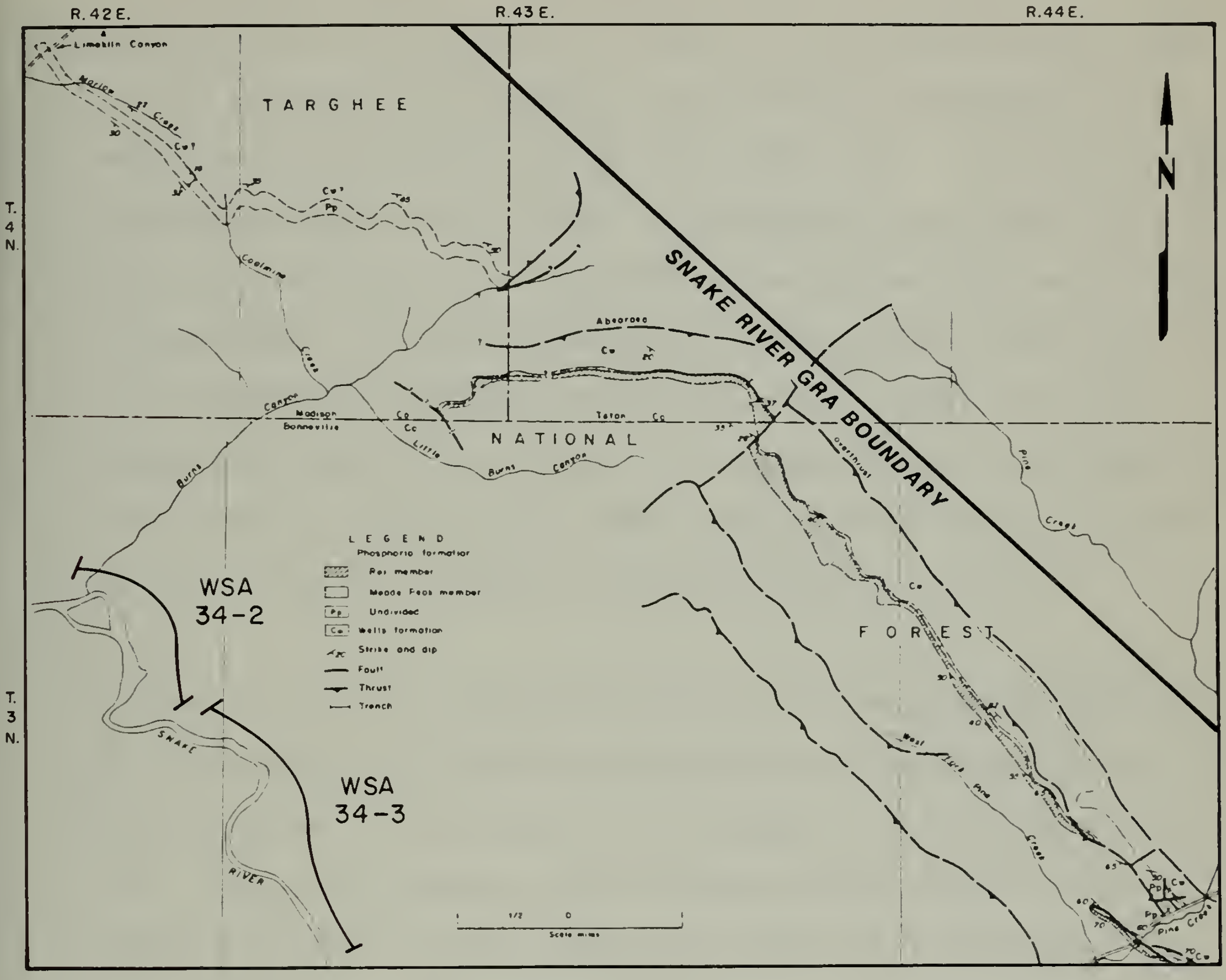
TABLE IV

PHOSPHATE RESOURCES[1] OF THE SNAKE RIVER GRA, IDAHO

District	Cutoff Grade (% P_2O_5)	Tonnage (Short tons)	Source of Data
Snake River Range (northwestern portion)	+31	20,800,000	Coffman and Service (1967)
	+24	58,700,000	
	+18	72,000,000	
	+10	87,900,000	
Swan Valley	+31	8,400,000	Service (1966)
	+24	2,100,000	
	+18	13,500,000	
	+10	16,300,000	

---

[1] Above drainage entry level.



From: Coffman and Service (1967).

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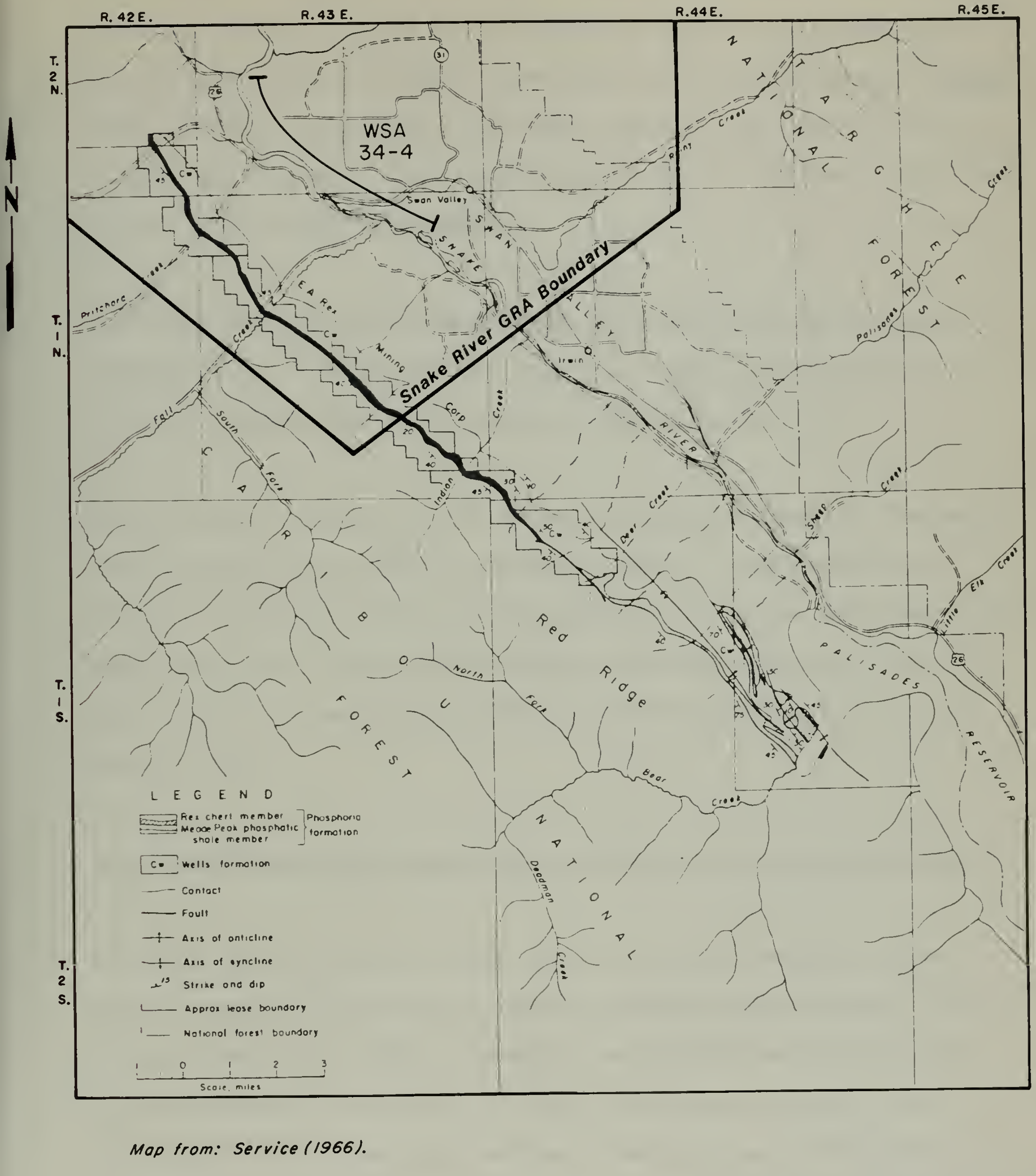
REGION 2 NORTHERN ROCKY MOUNTAINS

Snake River GRA, Idaho
Northwestern Snake River
Range Phosphate District

SCALE AS SHOWN			FIGURE
DATA BY	DATE 3/1983	REV. SEC	12
DRWN BY DSI	APRVD G.F.		

Meade Peak Phosphatic Shale Member of the Phosphoria Formation is exposed on the limb of a partially overturned faulted anticline (Service, 1966). Two complete (loc. 17 and 19, Fig. 10, Table II) and one partial section (loc. 22, Fig. 10, Table II) of the Meade Peak Phosphatic Shale Member were sampled and analyzed (Jobin and Schroeder, 1964). Most of the highest grade phosphate at these three localities is concentrated in two layers: (1) a 5 to 10 foot thick bed near the top of the Meade Peak and (2) a bed of similar thickness about 10 feet above the base of the Meade Peak. Both layers average approximately 20% P_2O_5 (Jobin and Schroeder, 1964). There was considerable exploration activity in the southeastern part of the district in the 1950s and 1960s (Service, 1966). However, today only the northern part of the district is covered by phosphate leases (Fig. 15).

Vanadium is associated with phosphate beds in the Phosphoria Formation and has been recovered as a by-product of phosphate mining and processing. The vanadium content of the phosphate rock averages 0.2 to 0.3% V_2O_5 (Fischer, 1964). Jobin and Schroeder (1964) show that vanadium values from their samples on Pritchard and Fall Creeks range from 0.01 to 0.64% V_2O_5. The highest values occur in mudstones with intermediate P_2O_5 values and a high insoluble residue. Vanadium also occurs in carbonaceous shales associated with the phosphorite beds. Fischer (1964) describes one three-foot thick bed, referred to as the "vanadiferous zone", as containing 0.7 to 0.9% V_2O_5. The Conant Valley cinder deposit (loc. 14, Fig. 10, Table II) has been mined for road ballast. A large pit exposes 75 to 100 feet of brown to gray-black cinders and pyroclastic fragments. The fragments include pink rhyolitic tuff, scoria, and occasionally a rounded pebble of sedimentary rock. This deposit is moderately to poorly cemented and overlain by black to gray



Map from: Service (1966).

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Snake River GRA, Idaho
Swan Valley Phosphate District

SCALE AS SHOWN
DATA BY
DATE 3/1983
DRWN BY DSI
APRVD G F
FIGURE 13

compacted tuff and a basalt flow. The latter exhibits pillow structure indicating that the pyroclastic accumulated in a ponded environment (Savage, 1961). No data is available on the other reported cinder deposits (loc. 2 and 15, Fig. 10, Table II) in the Snake River GRA, but presumably they are similar to the Conant Valley deposit.

Pumice may have also been produced from the Conant Valley cinder deposit (Mitchell et al., 1981) but data is sparse. Several pumice processing plants are located about 20 miles east of the Snake River GRA.

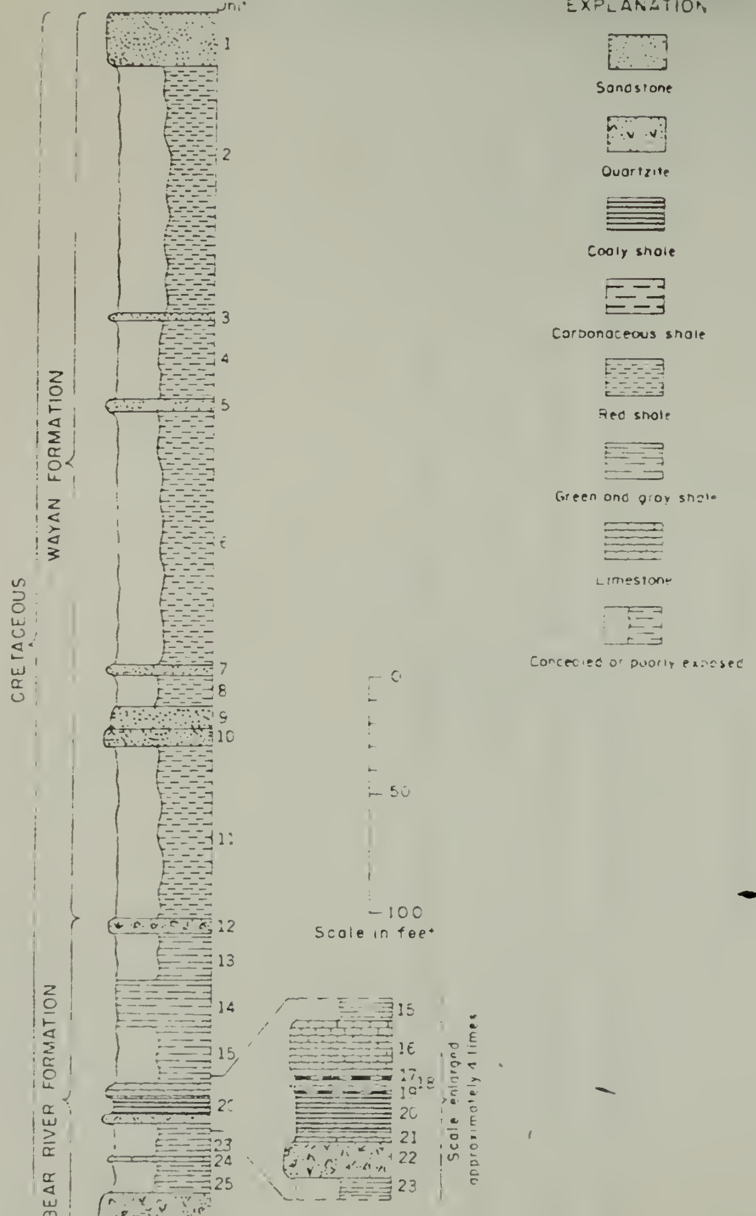
Sand and gravel deposits occur in islands and along the banks of the Snake River alluvial plain (Jobin and Schroeder, 1964). These resources are plentiful in Bonneville County (Savage, 1961) and have been exploited in the Snake River GRA in sec. 1, T.1N., R.43E. and in sec. 8, T.3N., R.41E. (Fig. 10). The WSAs in the Snake River GRA are entirely underlain by alluvial sand and gravel.

3.3 Known Mineral and Energy Prospects, Occurrences and Mineralized Areas

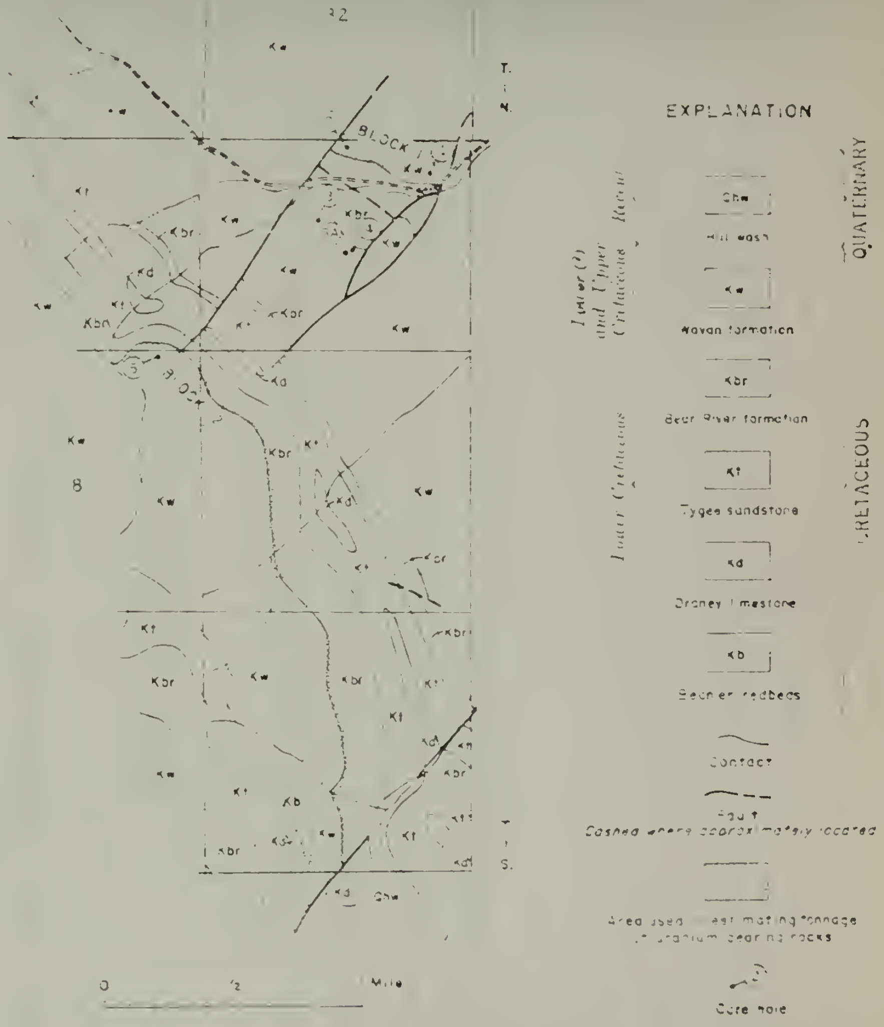
A uranium occurrence at Fall Creek (loc. 25, Fig. 10, Table II) in the southern part of the Snake River GRA, was sampled by Vine and Moore (1952) and described by Vine (1959). Anomalous radioactivity and uranium values are concentrated in 1 to 2 feet of highly carbonaceous to coaly shale interbedded with carbonaceous limestone in the upper part of the Bear River Formation (Fig. 14). Vine (1959) estimated the resources in the Fall Creek area at 6,500,000 tons averaging 0.02% uranium. The nature of the uranium minerals at Fall Creek is not known (Vine, 1959).

Thin coal layers also occur in the carbonaceous shales at the Fall Creek uranium occurrence (Vine, 1959). The prospect, originally called the Joseph Smith mine, was explored for coal in 1922 (loc. 3, Fig. 11, Table III) when Joseph Smith drove a 100 foot decline in carbonaceous rocks located on a tightly folded and faulted anticline. The drift is at a 33° angle and follows the dip of the coaly beds. Limestone forms the headwall. Much shearing and slippage is apparent in the coaly layers, with clay and shale fragments squeezed into them. The coal is too impure and low grade to be of commercial value, although one early investigator called this deposit the best in the area (Savage, 1961). Kilsgaard (1964) reports a heat value of about 3,000 Btu for samples of coal from Fall Creek. The coal occurs in the Cretaceous Bear River Formation and the Fall Creek exposure is part of the Willow Creek-Caribou coal district. Coals in this district are characterized by high moisture and ash contents and low heat values (Kilsgaard, 1964).

Extensive hydrocarbon leases are presently held throughout southeastern Idaho and 60 hydrocarbon tests, two of which are in or near the Snake River GRA, have been drilled in the area. Thirty of these were over 5,000 feet deep (Breckenridge, 1982). Shows of oil and gas have been reported in a number of the tests but to date all have been plugged and abandoned. Exploration drilling continues in the area (McCaslin, 1982). In the Snake River GRA, one hydrocarbon test has been drilled in the western part of the Snake River GRA (loc. 1, Fig. 11, Table III). This test was drilled between 1928 and 1930 by the California Oil Company to a depth of 3,774 feet, bottoming in the Wells Formation (Idaho Oil and Gas Conservation Commission). No oil or gas shows were reported (Appendix II). Another test,



Stratigraphic Section Measured At Fall Creek.



From: Vine (1959).

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Snake River GRA, Idaho

Fall Creek Area Geologic Map and Stratigraphic Section

SCALE AS SHOWN		FIGURE
DATA BY	DATE 3 1983	14
DRAWN BY DSI	APPVD G.F.	

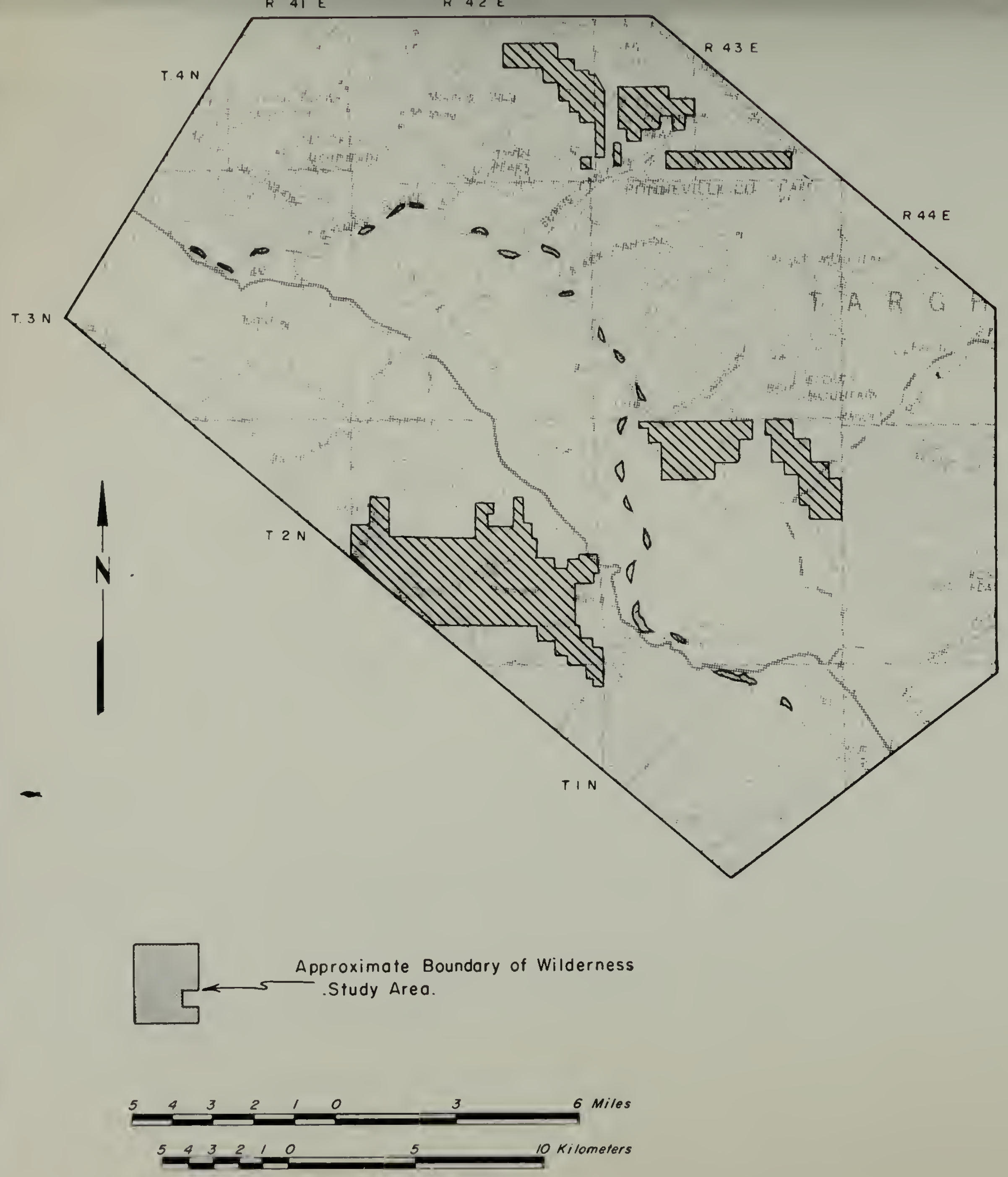
drilled by Conoco Inc., is located in section 21, T.2N., R.41E., two miles southwest of the GRA and four miles south of the California Oil Company test. Information on the Conoco well, including total depth, is still confidential.

Bentonite, or decomposed volcanic ash, is present along the southwest bank of the Snake River (loc. 28, Fig. 10, Table II) in an exposure of the Salt Lake Formation. Only a few inches thick, the bentonite layers are not present in commercial quantities at this site (Savage, 1961).

3.4 Mining Claims, Leases and Material Sites

A review of BLM claims records current to June 6, 1982 shows no active unpatented mining claims in the Snake River GRA. No patented mining claims are present based on a review of BLM Master Title plats current to August 8, 1982. Phosphate leases cover approximately 15% of the GRA (Fig. 15). However none of the leases overlap any of the WSAs.

A review of BLM oil and gas plats current to August 8, 1982 shows approximately 60% of the Snake River GRA is covered by oil and gas leases (Fig. 16) including most of WSAs 34-2 and 34-3 (Table V). Coal lease applications cover parts of the northeast and southwest portions of the GRA (Fig. 16).


R 41 E
R 42 E
R 43 E
R 44 E
T. 4 N
T. 3 N
T 2 N
T I N
N
Approximate Boundary of Wilderness Study Area.
5 4 3 2 1 0 3 6 Miles
5 4 3 2 1 0 5 10 Kilometers

EXPLANATION

x Unpatented Mining Claim

▲ Patented Mining Claim

▨ Phosphate Lease

Notes: 1) Number adjacent to symbol indicates number of mining claims in that section.

2) Area of search: Entire GRA

3) Source of Data: BLM Claims Records and MT Plats.

4) Data current to: Claims - June 7, 1982.
Leases - Aug. 8, 1982.

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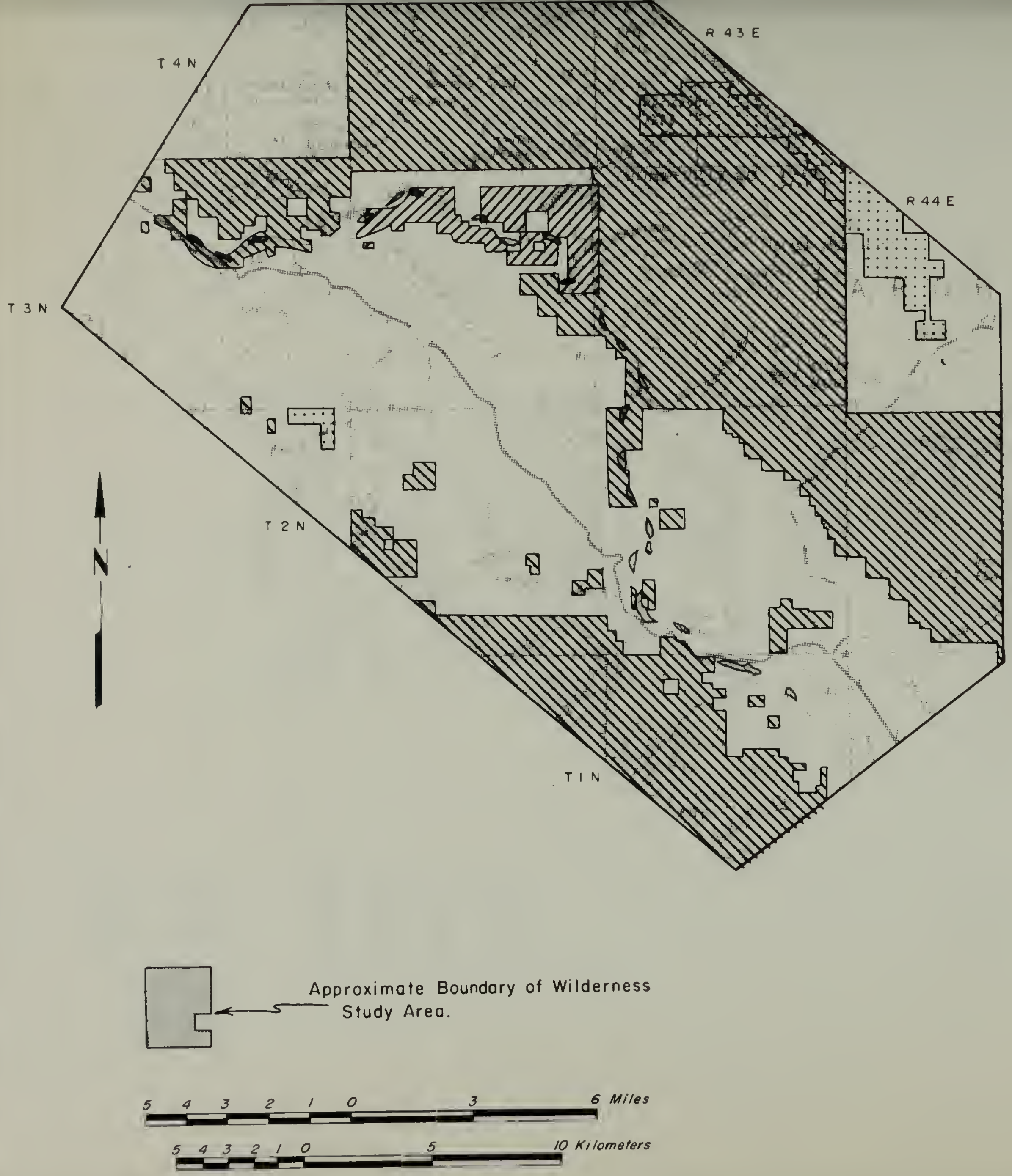
BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Snake River GRA, Idaho

Mining Claims and Phosphate Leases

SCALE 1"=4 MILES			FIGURE
DATA BY WGM	DATE 1/1983		15
DRWN BY DSI	APRVD GF		


R 43 E
R 44 E
T 4 N
T 3 N
T 2 N
T 1 N
N
Approximate Boundary of Wilderness Study Area.
5 4 3 2 1 0 3 6 Miles
5 4 3 2 1 0 5 10 Kilometers

LEGEND

▨ *Area covered by oil and gas leases.*

▨ *Area covered by oil and gas lease application.*

▦ *Coal Lease Application*

Notes: 1) Area of Search: Entire GRA
2) Data current to: Aug. 8, 1982
3) Source of Data: BLM oil and gas plats

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Snake River GRA, Idaho

Oil and Gas Lease Status

SCALE 1"= 4 MILES			FIGURE 16
DATA BY WGM	DATE 1/1983		
DRWN BY DSI	APRVD G.F		

TABLE V

OIL AND GAS LEASES IN WSAs IN THE SNAKE RIVER GRA, IDAHO

WSA	Lease No.	Owner of Record	Date Issued
34-2	?	Tom Notestine 3401 Kootenai Boise, Idaho 83705	2-18-82 (Application filed)
	I 10558	Cities Service Company Box 300 Tulsa, Oklahoma 74102	8-01-78
	I 13230	The Anschutz Corp. 2400 Anaconda Tower 555 - 17th Street Denver, Colorado 80202	7-01-79
34-3	I 10339	Sun Exploration & Production Company P.O. Box 340180 Dallas, Texas 75234 Wexpro Company P.O. Box 11070 Salt Lake City, Utah 84147 Champlin Petroleum Company P.O. Box 1257 Englewood, Colorado 80150 The Anschutz Corp. 2400 Anaconda Tower 555 - 17th Street Denver, Colorado 80202	8-01-78
	I 10349	Same as Lease I 10339	8-01-78
	I 10350	Same as Lease I 10339	8-01-78
	I 12794	Same as Lease I 10339	8-01-78
34-4	I 10569	Cities Service Company Box 300 Tulsa, Oklahoma 74102	9-01-78
	I 13225	?	? (Application filed)
	I 13226	?	? (Application filed)

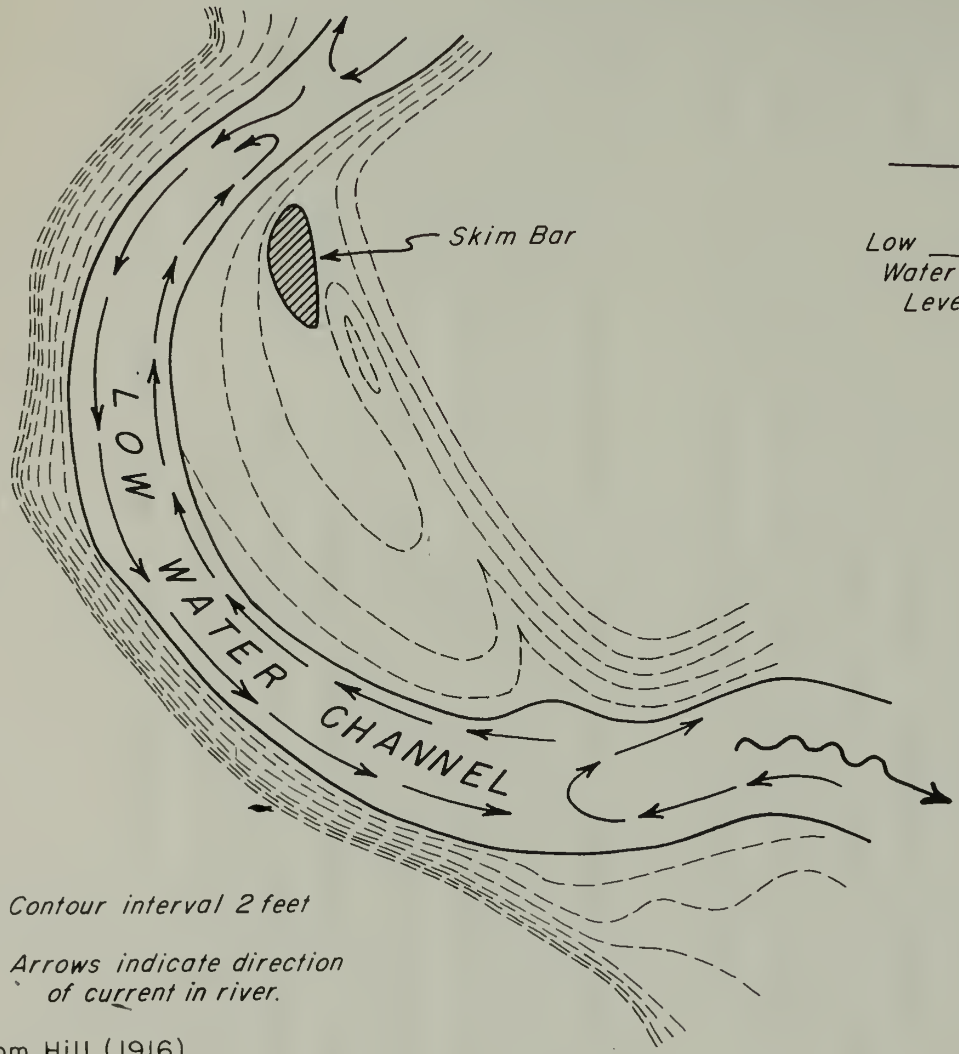
3.5 Mineral and Energy Deposit Types

Although the rocks underlying the Snake River GRA contain a moderately diverse assemblage of mineral deposits and occurrences including placer gold, uranium, high calcium limestone, phosphate, cinders, and sand and gravel; the deposit types which can be expected to occur in the WSAs are limited. The WSAs are within the Starr Valley-Swan Valley depression, a graben. The bounding normal faults have displacements of thousands of feet (Blackstone, 1977). As uplift proceeded, grabens like Swan Valley were rapidly filled with coarse clastics eroded from the adjacent ranges (Savage, 1961). These clastics are overlain by 200 to 600 feet of volcanics. Thus, in the Swan Valley the pre-Tertiary section is probably at least 2,000 feet or more below the present erosional surface. In addition, the WSAs encompass a series of over 40 islands in the Snake River; therefore, they are underlain entirely by alluvial sand and gravel. From the above discussion, it is apparent that only placer gold and sand and gravel are likely to occur near the surface within the WSAs. The presence of volcanics and coarse clastics in the Tertiary section suggests a favorable environment in the subsurface for uranium deposits, but no data is available with which to make a meaningful assessment. Potential also exists in the subsurface for geothermal resources and oil and gas since these resources can be exploited by deep drilling. In most cases, however, the latter two resources could be exploited by drill holes outside the WSAs since the individual islands represent small parcels of land distributed a river segment 25 miles in length.

There was considerable interest in gold placer mining on various parts of the Snake River prior to 1900 (Schultz, 1907; Staley, 1945). Activity largely died out by the 1930s and today is confined to a few sporadic operations (Bergendahl, 1964; Wells, 1973). Numerous papers were published on the Snake River placers and summaries of early references are given by Hite (1933a) and Hill (1916).

The gravels in the Snake River from Moran, Wyoming to the mouth of the Boise River have been intermittently worked for gold for many years (Hill, 1916). Placer deposits along the Snake River occur in both active stream sediments and in older bench placers (Schultz, 1907; Hite, 1933a). It appears that stream placers are the more common type of deposit. The gold is very fine-grained "flour" gold; generally less than 150 mesh in size. This caused numerous recovery problems for the early miners (Fahrenwald et al., 1939). The particles are usually oval or disc-shaped flakes (Hite, 1933b). A particular type of stream placer called a "skim bar" by Hill (1916) or "flood gold" by Wells (1973) seems to predominate. Washburn (1900) notes that the gold is most abundant at the head ends of bars deposited along the short or inner sides of curves, and that these bars are enriched by every flood. The top layer of gravel is richest, and bedrock concentration is not usual.

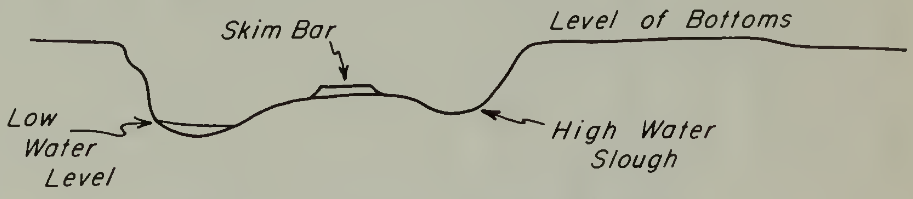
Hill (1916) illustrated the depositional model of skim bar placers (Fig. 17). The depositional setting described in Hill's model is at the head of a point bar (Leopold and Wolman, 1960; Leopold et al., 1964). Gold deposition occurs during periods of overbank flow. Wells (1973) and other authors emphasize the erratic distribution of gold in these placer deposits. The



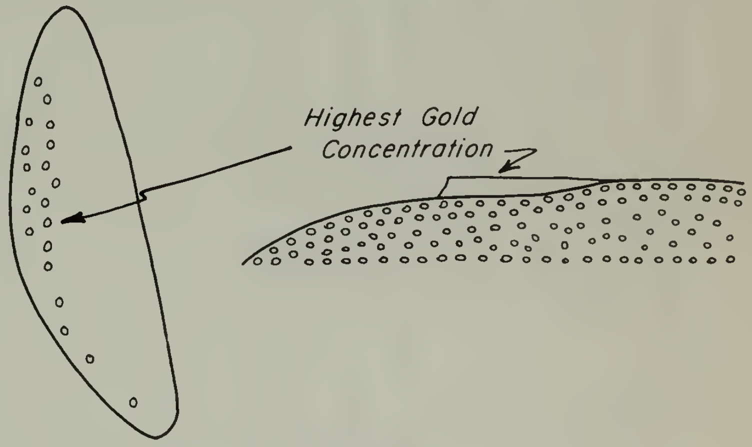
* Contour interval 2 feet

* Arrows indicate direction of current in river.

From Hill (1916).



CROSS SECTION OF SKIM BAR



SKIM BAR ENLARGED

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Snake River GRA, Idaho

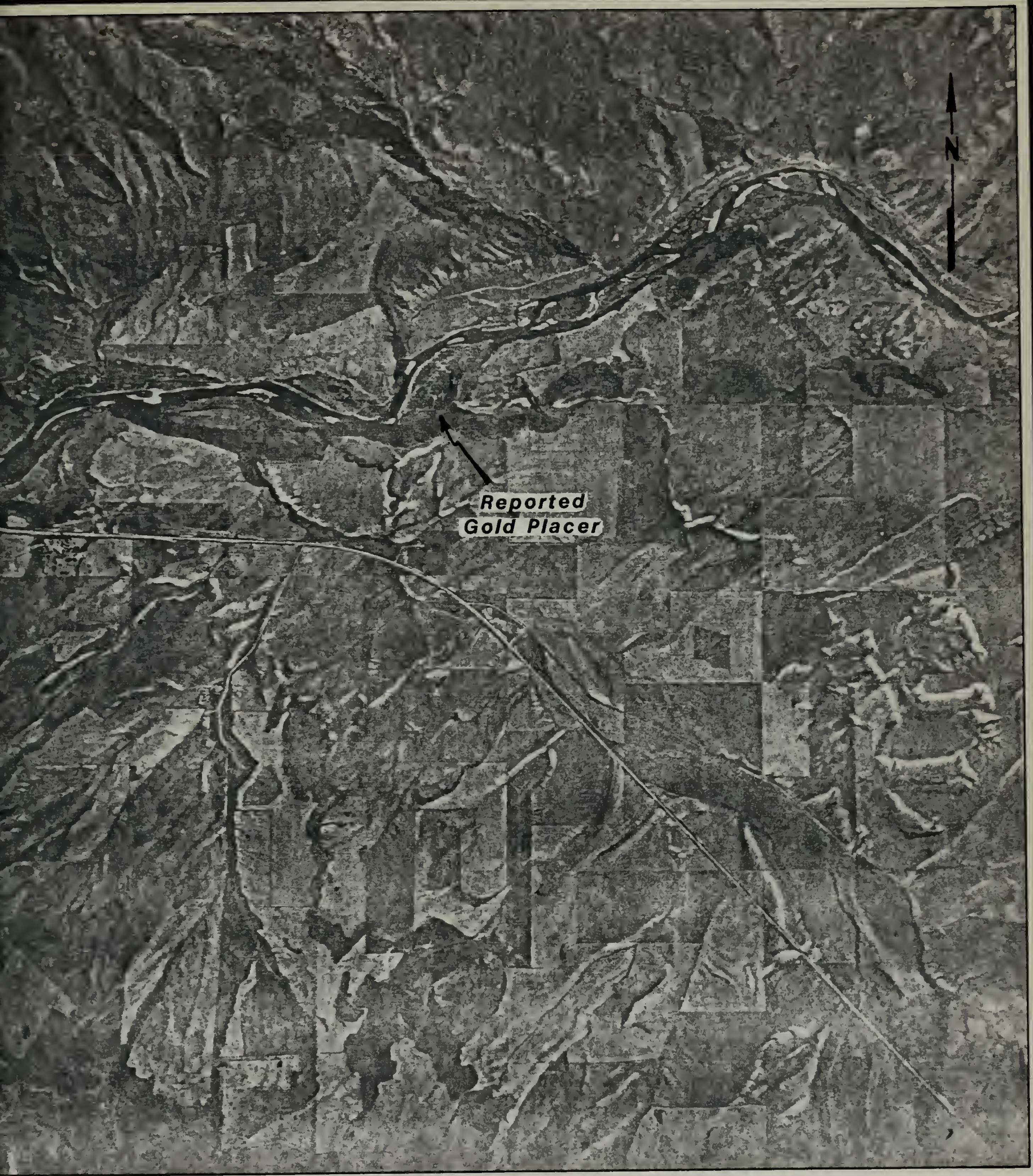
Sketch Showing Location of Flood Gold on Accretion or Skim Bars

SCALE NO SCALE		FIGURE
DATA BY WGM	DATE 3/1983	17
DRWN BY DSI	APRVD G F	

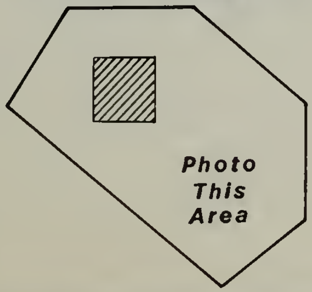
Roy Coles placer is located on a point bar (Fig. 18) and Savage (1961) also describes erratic paystreaks at the placer. Thus, the geomorphic setting and distribution of gold at the Roy Coles placer fit the skim bar model described by Hill (1916). Although Hill's (1916) model is on the inside of a meander bend, it should be emphasized that similar deposition should occur marginal to islands in the river channel (Leopold et al., 1964). As a result accumulations of flood gold can be expected within WSAs 34-2, 3 and 4.

Practically all of the alluvial gravels in the valley of the Snake River contain gold, but in most places the gold content is very low (Hill, 1916). There are few specific references to the grade and yardage of individual Snake River placers in the literature. Early papers (Schultz, 1907; Hill, 1916) indicate that most of the operations were small. Later writers (Hite, 1933a, b; Hite and Waring, 1935; Staley, 1945) describe larger scale dredging operations, but none of operations were successful.

From the existing descriptions it appears that the gold placers in the Snake River drainage can locally have high grades, but the paystreak is erratic and the high grade yardage is limited. Since these deposits are formed during periods of flooding, new ones are formed and older ones destroyed during each new period of flooding; thus, these deposits are theoretically renewable as long as gold is present in the Snake River drainage system. However, most gold in the drainage system upstream from the Snake River GRA is probably now trapped in the Palisades Reservoir.



Location Map



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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Snake River GRA, Idaho

Areal Photograph Showing Location of Roy Coles Gold Placer

SCALE 1" = 24 MILES APPROXIMATLEY			FIGURE
DATA BY WGM	DATE 1/1983	REVISED	18
DRWN BY DSI	APRVD G.F		

Most uranium is derived from felsic igneous rocks such as granite, syenite, pegmatite, and rhyolite. Because of its large ion size, uranium does not enter the ordinary rock-forming minerals except as inclusions. During the formation of granitic masses, uranium: (1) forms its own minerals, (2) forms an intergranular film, (3) enters some accessory minerals such as zircon, sphene, or biotite, or (4) concentrates in late magmatic differentiates such as veins and pegmatites.

The average uranium content of the earth's crust is about 2 ppm, and that of granite is about 4 ppm. Felsitic volcanic rocks generally contain more uranium than their plutonic equivalents, perhaps as much as 50% more. To be commercially exploitable, a uranium deposit must ordinarily contain at least 1,000 ppm or one kilogram per ton. Thus, concentration by later geologic processes is usually necessary to form an economic uranium deposit. The uranium minerals in igneous rocks are mostly in the tetravalent state and oxidize readily to provide hexavalent uranium. Hexavalent uranium is soluble in ground waters. During transport by ground water, uranium may be: (1) partially absorbed by clay or carbonaceous matter, (2) precipitated in a chemically hospitable environment by reduction or evaporation, or (3) combine with another element to form a mineral stable in the oxidized state. If carried to the ocean, it tends to: (1) precipitate with phosphatic sediments, or (2) be absorbed by organisms and/or carbonaceous mud. The uranium-bearing accessory minerals, being resistant to erosion, are more likely to weather out of the igneous host as detritus and become dispersed in detrital sediments or, more rarely, concentrated into placers.

Sandstone deposits account for about 95% of United States uranium reserves. The hosts are river-borne arkosic sandstone deposits, commonly intercalated with acidic tuff and clay beds. The tuffs and/or nearby granitic uplifts, and the arkose itself, are thought to be the source rocks. The uranium is dissolved from the source rocks by meteoric water. The course of these uranium-bearing meteoric waters is directed by clay beds or old channel scours, and the precipitating medium for the uranium is believed to be organic matter. Somewhat surprisingly, therefore, lignite deposits rarely have associated ore, though they may be quite anomalous in uranium. Deposits are individually small (with exceptions) with grade ranging from 3 to 8 pounds per ton. Uranium in peneconcordant sandstone deposits is accompanied by iron (as pyrite if the ore is unoxidized) and in many cases by copper, molybdenum, selenium, and vanadium.

From the above discussion of uranium deposits it can be seen that the Tertiary and Quaternary coarse clastic units which underlie the alluvium in the Snake River valley may constitute favorable host rocks for sandstone uranium deposits. Felsic volcanics are present in the Tertiary column. In addition, evidence exists that a complex hydrologic system is associated with the fault system present in the valley. However, no data exists on which to base an evaluation of these rocks for their uranium potential.

Sand and gravel resources are abundant in the valley of the Snake River. Consequently, the small acreage involved in the WSAs is not likely to critically affect the sand and gravel resources present in the region.

The hydrocarbon potential for southeastern Idaho was first discussed by Kirkham (1922, 1924, 1935) and Heald (1922). Kirkham suggested that source and reservoir beds and geologic structures potentially favorable for hydrocarbon accumulation are present in southeastern Idaho. Recently, Peterson (1977) summarized the source and reservoir characteristics of rocks in the eastern Great Basin and western Rocky Mountain shelf from the Cambrian to the Jurassic periods. He concluded that the paleogeographic-environmental factors present provide an excellent combination favoring generation and early accumulation of petroleum in several parts of the stratigraphic section, particularly the middle to late Paleozoic.

The nearest commercial hydrocarbon production to the Snake River GRA is from 20 fields, approximately 40 to 140 miles southeast, in the "overthrust belt" of southwestern Wyoming and northern Utah. This area has been developing rapidly in the past eight years (McCaslin, 1981b). It is now recognized as a major petroleum province (Powers, 1977) with at least three giant oil fields (Lamb, 1980; McCaslin, 1981a). Several fields have multiple pay horizons. Production is now known from at least eight horizons in the Paleozoic and Mesozoic. Powers (1977) estimates that between 0.6 to 3.0 billion barrels of oil and 4.0 to 12.0 trillion cubic feet of gas will be produced from the Idaho-Wyoming-Utah thrust belt.

The pre-Cenozoic subsurface of the Snake River GRA is probably stratigraphically similar to the rocks underlying the northern Utah and southwestern Wyoming thrust belt and the GRA is within the northern extension of the same structural province. The Nugget Sandstone, a major reservoir bed in the Utah-Wyoming area, consists of a cross-stratified sandstone facies with

porosities of 12 to 15% (Picard, 1977). Kamis (1977) studied the Nugget in southeastern Idaho. He found that porosities were low due to diagenetic sealing; therefore, he concluded that the Nugget has little reservoir potential in southeastern Idaho. However, there are seven other recognized producing horizons in the Utah-Wyoming area which have potential equivalents in the Snake River GRA and there are other potential reservoir beds in the area. The recognition of the Phosphoria Formation as an excellent source bed (Claypool et al., 1978; Peterson, 1980) increases the hydrocarbon potential of the Snake River region. Thus, considering all the analyses and evidence for hydrocarbon potential in southeastern Idaho, the potential for the Snake River GRA must be considered as at least moderately favorable.

In the most recent geothermal classification of the United States (Muffler, 1979), geothermal resources were divided into six categories. These are:

1. Conduction-dominated regions
2. Igneous-related geothermal systems
3a. High temperature (over 150°C) hydrothermal convection systems
 b. Intermediate temperature (90-150°C) hydrothermal convection systems
4. Low temperature (less than 90°C) hydrothermal convection systems
5. Geo-pressured geothermal energy systems

For the purposes of this assessment these classes can be reduced to two: (1) high temperature (over 150°C) hydrothermal convection systems and (2) low/intermediate temperature (40-150°C) hydrothermal convection systems. Geo-pressured geothermal energy systems do not exist in the areas discussed. Thereotically, geothermal resources exist everywhere because the temperature

of the earth's crust everywhere increases with depth. Thus, high temperatures are reached at some depth below any given point on the earth's surface. However, for the foreseeable future, a naturally occurring hot fluid coupled with sufficiently porous and permeable rocks to allow fluid migration are prerequisites for practical use of geothermal energy; thus, conduction-dominated and "magma-tap" geothermal systems are not included in this evaluation.

Western Montana and southern Idaho are included in the Cordilleran fold-thrust belt of western North America. Volcanic and tectonic processes have been active in these areas within the past few millions of years and there are extensive manifestations at the surface of geothermal resources. The portion of the Cordilleran fold-thrust belt within GEM Region 2 can be divided into six provinces of different geothermal significance:

TABLE VI

GEOTHERMAL PROVINCES IN GEM REGION 2

1. Montana Thrust/Foothills
2. Montana Basin and Range
3. Central Idaho Basin and Range
4. Idaho Batholith/Blue Mountains
5. Southeastern Idaho Basin and Range
6. Snake River Plains

The Snake River GRA is within the Southeastern Idaho Basin and Range province.

The Southeastern Idaho Basin and Range geothermal province is similar in many respects to the Central Idaho Basin and Range province, particularly with respect to the geological setting. Rocks underlying both provinces are extensively folded and thrust-faulted Precambrian and Paleozoic sedimentary rocks. Also, the hydrology in both provinces is complicated because of the abundance of carbonate bedrock. In contrast to the Central Idaho Basin and Range province, there are several exposures of young volcanic rocks in the Southeastern Idaho Basin and Range province. For example, there is an extensive area of very young (less than 100,000 years old) silicic and basaltic volcanic rocks near the Blackfoot Reservoir in the center of the province (Mitchell et al., 1980). The Southeastern Idaho Basin and Range province is continuous with the much more extensive classical Basin and Range province of Utah and Nevada. A number of deep hydrocarbon tests have been drilled in the Basin and Range province and very high temperatures have been reported from depths of 2 to 3 miles. Heat flow in the Southeastern Idaho Basin and Range province is possibly higher than the Montana or the Central Idaho Basin and Range province and might range from 75 to 100 milliwatts per square meter. Geochemical data from the Southeastern Idaho Basin and Range province suggest very high "base" temperatures for some of the geothermal resources (Mitchell et al., 1980). However, the presence of these high temperature geothermal systems has not been demonstrated by deep drilling at this time except for the Raft River system where experimental exploitation of electrical geothermal resources is in progress.

The South Fork of the Snake River, which includes WSAs 34-2 to 34-4, follows a northwest-southeast trending major linear feature of southeastern Idaho, the Heise-Alpine trend. This trend consists of a series of valleys floored

by alluvium or Quaternary volcanics which intersect the Snake River Plains at right angles near Idaho Falls (Day, 1974; Haskett, 1976). The area is a part of the Intermountain Seismic Belt characterized by the occurrence of numerous microearthquakes (Smith, 1978).

In addition to the Fall Creek thermal spring, three other geothermal manifestations occur along the Heise-Alpine trend. Elkhorn Warm Springs and Heise Hot Springs occur 4-6 miles northwest of the westernmost WSA. About 25 miles southeast of the easternmost WSA, Alpine Warm Spring occurs along the Snake River (Mitchell et al., 1980). Elkhorn Warm Spring has a surface temperature of 22°C but little else is known about it. Heise Hot Springs has a discharge of 227 l/min of 49°C water. The geochemical aquifer temperature (Si-Chalcedony) is 79°C. Both of these springs are along the southern edge of the postulated location of the Rexburg Caldera (Mabey, 1978) which may have been active during late Miocene. It is probably the source of a large ash flow (McBroom et al., 1981). A large geothermal anomaly which bounds the northwestern edge of the Snake River Range/Big Hole Mountains occurs at the northeast edge of this caldera (Brott et al., 1976). Alpine Warm Spring, southeast of the WSAs, has a surface temperature of 37°C, a flow of 94 l/min, and an estimated aquifer temperature of 61°C (Si-Chalcedony). Crosthwiate (1979) sampled Heise Hot Springs, two cold springs along the Heise-Alpine Trend and several cold springs in the Snake River Range. The water in the cold springs sampled by Crosthwiate does not appear to have a significant thermal component.

Due to the paucity of data the geothermal resource potential of the Snake River GRA must be evaluated on the basis of the regional setting. South-

eastern Idaho may have potential for electrical grade geothermal resources but no deep exploration has been carried out at this time. The GRA lies along a major regional lineament, the Heise-Alpine trend, and it is seismically active. Furthermore, both Quaternary volcanics and permeable rocks underlie the GRA. These factors indicate that the heat flow and gradients in the GRA are probably above normal; therfore, significant geothermal potential exists in the Snake River GRA. The hydrology is undoubtedly complicated because of the very complicated geologic structure and because of the existence of many permeable units in the geologic section.

3.6 Mineral and Energy Economics

Savage (1961) reports that the Roy Coles placer yielded \$5 per cubic yard of gravel and that lean placers yielded \$0.25 to \$1.00 per yard. Converting these values to reflect modern gold prices (\$400/ounce) gives \$57/yd and \$3 to \$11/yd. As mentioned previously the pay streaks in skim bar placers, such as those in the Snake River are very erratic. Wells (1973) had a low opinion of deposits of this type stating: "Good surface showings of fine-size gold are not uncommon and although they may appear to be valuable, experience has shown that in most cases the gravel a few inches beneath these surface concentrations is nearly worthless." However, these deposits can be profitably exploited on a small scale by individuals during periods of high gold prices. On this basis reserves are practically inexhaustable. Wells (1973) points out that in many gold provinces, particularly in parts of South America, river bars have been mined year after year from time immemorial. They are not permanently exhausted because each year floods deposit a new supply of gold, a process which continues indefinitely. The

Snake River, however, has been dammed upstream from the Snake River GRA; thus, renewal of river placers may now be greatly diminished or perhaps no longer occur.

Production of sand and gravel is the second largest non-fuel mineral industry in the United States (Tepordei, 1980). Sand and gravel are used primarily as aggregate in the construction industry. They are high-bulk, low-value commodities and as such are sensitive to transportation costs (Dunn, 1975). Although the WSAs in the Snake River GRA are underlain entirely by sand and gravel, these deposits are abundant and also closer to market elsehwere in the region.

The recent deregulation of natural gas prices and the increasing prices of oil during the past nine years have lead to increased domestic exploration in an effort to lessen United States reliance on imported oil. Numerous environments which would not have been explored in the past are being evaluated today. The generally favorable geologic setting of the Snake River GRA and the well developed infrastructure make the development of any existing oil or gas deposits in the GRA economically attractive.

Based on present requirements for use of hot fluids in electrical generating techniques, geothermal systems with temperatures of less than 150°C can not be considered to have significant potential for electrical exploitation. These systems, however, can have a significant potential for low and intermediate temperature geothermal utilization for space heating, material processing, etc. if their minimum temperature exceeds 40°C. At the lower end of the spectrum, as the energy content of the resource becomes less, or

the drilling depth necessary for exploitation becomes greater, there is a very ill-defined cutoff. For example, shallow ground water temperatures on the order of 10-20°C can be used for heat pump applications, and in some cases these are considered geothermal resources. However, for the purpose of this discussion, a lower temperature than approximately 40°C is considered a cutoff for a geothermal resource. Another important economic factor affecting the viability of a geothermal resource is the distance from the source to the point of consumption. At lower temperatures it is not feasible to consider long-distance transportation of geothermal energy whereas for electrical grade resources long transportation distances are of course feasible. Of course many of the warm springs in the western United States have been used for recreational purposes regardless of location.

Given the geomorphic setting and small size of the WSAs in the Snake River it is likely that oil and gas as well as geothermal resources could be developed without direct impact on the WSAs.

4.0 LAND CLASSIFICATION FOR GEM RESOURCES POTENTIAL

4.1 Explanation of Classification Scheme

In the following section the land within the three WSAs in the Snake River GRA is classified for geology, energy and mineral (GEM) resources potential. The classification scheme used is shown in Table VII. Use of this scheme is specified in the contract under which WGM prepared this report.

The evaluation of resource potential and integration into the BLM classification scheme has been done using a combination of simple subjective and complex subjective approaches (Singer and Mosier, 1981) to regional resource assessment. The simple subjective approach involves the evaluation of resources based on the experience and knowledge of the individuals conducting the evaluations. The complex subjective method involves use of rules, i.e. geologic inference, based on expert opinion concerning the nature and importance geologic relationships associated with mineral and energy deposits (Singer and Mosier, 1981). The GEM evaluation is the culmination of a series of tasks. The nature and order of the tasks was specified by the BLM, however they constitute the general approach by which most resource evaluations of this type are conducted. The sequence of work was: (1) data collection, (2) compilation, (3) evaluation, and (4) report preparation. No field work was done in the Snake River GRA.

TABLE VII

BUREAU OF LAND MANAGEMENT GEM RESOURCES LAND CLASSIFICATION SYSTEM

CLASSIFICATION SCHEME	LEVELS OF CONFIDENCE
1. The geologic environment and the inferred geologic processes do not indicate favorability for accumulation of mineral resources.	A. The available data are either insufficient and/or cannot be considered as direct evidence to support or refute the possible existence of mineral resources within the respective area.
2. The geologic environment and the inferred geologic processes indicate low favorability for accumulation of mineral resources.	B. The available data provide indirect evidence to support or refute the possible existence of mineral resources.
3. The geologic environment, the inferred geologic processes, and the reported mineral occurrences indicate moderate favorability for accumulation of mineral resources.	C. The available data provide direct evidence, but are quantitatively minimal to support or refute the possible existence of mineral resources.
4. The geologic environment, the inferred geologic processes, the reported mineral occurrences, and the known mines or deposits indicate high favorability for accumulation of mineral resources.	D. The available data provide abundant direct and indirect evidence to support or refute the possible existence of mineral resources.

Each WSA is classified for locatable, leasable, and saleable resources potential.

Locatable minerals are those which are locatable under the General Mining Law of 1872, as amended, and the Placer Act of 1870, as amended. Minerals which are locatable under these acts include metals, ores of metals, non-metallic minerals such as asbestos, barite, zeolites, graphite, uncommon varieties of sand, gravel, building stone, limestone, dolomite, pumice, pumicite, clay, magnesite, silica sand, etc. (Maley, 1983).

Leasable resources include those which may be acquired under the Mineral Leasing Act of 1920 as amended by the Acts of 1927, 1953, 1970, and 1976. Materials covered under this Act include: asphalt, bitumen, borates of sodium and potassium, carbonates of sodium and potassium, coal, natural gas, nitrates of sodium and potassium, oil, oil shale, phosphate, silicates of sodium and potassium, sulfates of sodium and potassium, geothermal resources, etc. (Maley, 1983).

Saleable resources include those which may be acquired under the Materials Act of 1947 as amended by the Acts of 1955 and 1964. Included under this Act are common varieties of sand, gravel, stone, cinders, pumice, pumicite, clay, limestone, dolomite, peat and petrified wood (Maley, 1983).

4.2 Classification of the Table Rock Islands Wilderness Study Area (WSA 34-2)

4.2.1 Locatable Minerals

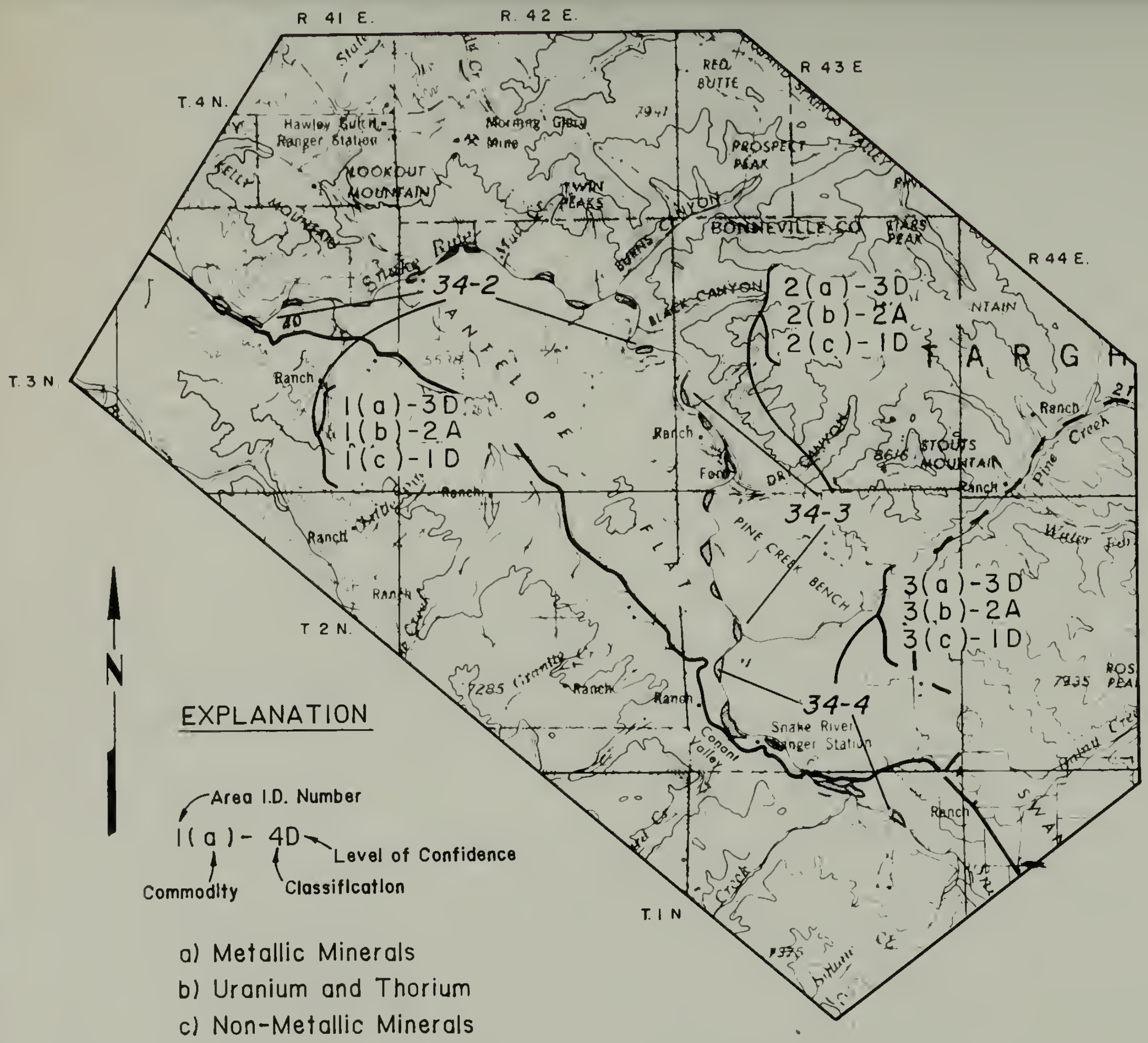
4.2.1a Metallic Minerals. The entire area of WSA 34-2 (1a, Fig. 19) is classified as having moderate potential for placer gold deposits based on direct evidence (3D). The basis for this classification are the concepts discussed in Sections 3.2 and 3.4

4.2.1b Uranium and Thorium. The entire area of WSA 34-2 (1b, Fig. 19) is classified as having low potential for uranium mineralization based on inadequate evidence (2A). The WSA is underlain by recent alluvial deposits and several thousand feet of volcanics and coarse clastics. Although the coarse clastics might constitute a favorable depositional site for uranium, no data is available.

4.2.1c Non-Metallic Minerals. The entire area of WSA 34-2 (1c, Fig. 19) is classified as unfavorable for locatable non-metallic minerals based on direct evidence (1D). The geological setting of the WSA is not favorable for these deposits.

4.2.2 Leasable Resources

4.2.2a Oil and Gas. All of WSA 34-2 (1a, Fig. 20) is classified as having moderate potential for oil and gas resources based on minimal direct evidence (3C). The reasons for the classification are the inferred



EXPLANATION

1(a)- 4D

Area I.D. Number

Commodity

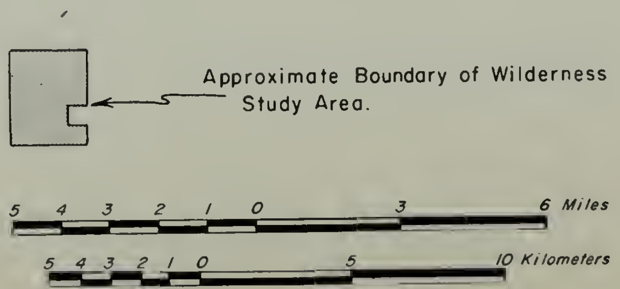
Classification

Level of Confidence

a) Metallic Minerals

b) Uranium and Thorium

c) Non-Metallic Minerals


Approximate Boundary of Wilderness Study Area.
5 4 3 2 1 0 3 6 Miles
5 4 3 2 1 0 5 10 Kilometers

BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

LEVELS OF CONFIDENCE

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVLEY MINIMAL TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

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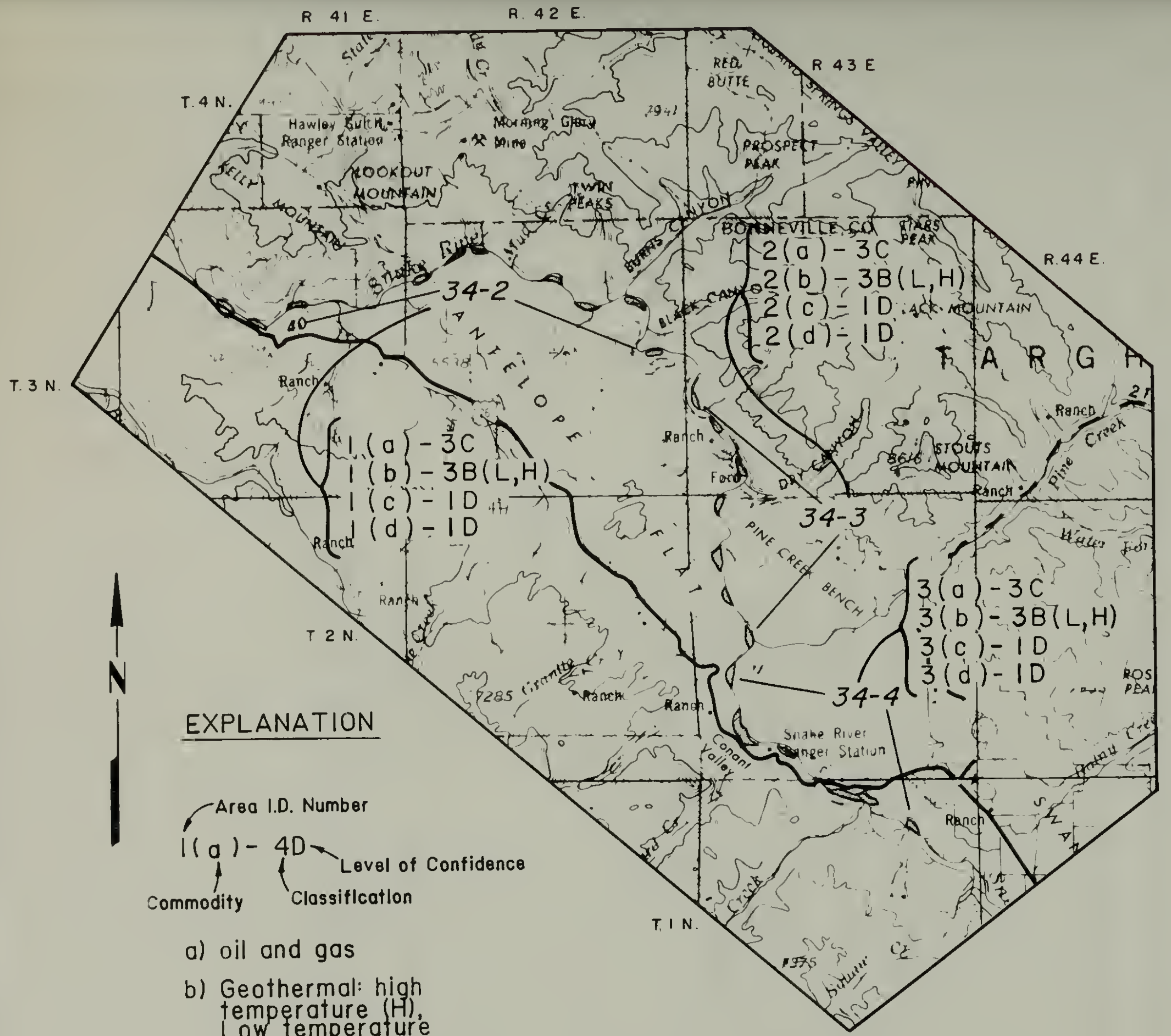
Anchorage, Alaska

BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Snake River GRA, Idaho
Wilderness Study Area
Land Classification
Locatable Resources

SCALE 1" = 4 MILES (1 250,000)		REVISED	FIGURE
DATA BY WGM	DATE 9/1982		19
DRWN BY DSI	APRVD G.F		



BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

LEVELS OF CONFIDENCE

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVLEY MINIMAL TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

EXPLANATION

1(a) - 4D

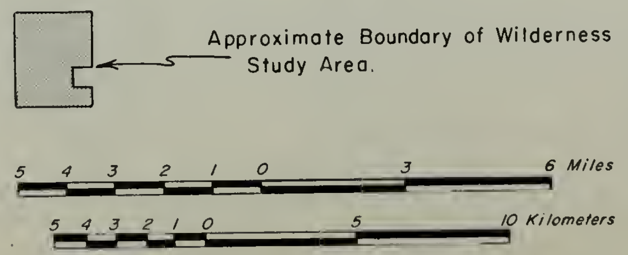
Area I.D. Number
Commodity
Classification
Level of Confidence

a) oil and gas

b) Geothermal: high temperature (H), Low temperature (L)

c) Sodium and Potassium

d) others: Asphalt (As) bitumen (bt), phosphate (ph), No specific commodity designation indicates that the rating applies to all of the above.


Approximate Boundary of Wilderness Study Area.
5 4 3 2 1 0 3 6 Miles
5 4 3 2 1 0 5 10 Kilometers

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Anchorage, Alaska

BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Snake River GRA, Idaho
Wilderness Study Area
Land Classification
Leasable Resources

SCALE. 1"= 4 MILES (1.250,000)		FIGURE
DATA BY. WGM	DATE 9/1982	REVISED
DRWN BY DSI	APRVD G.F	20

favorable geologic processes, the reported hydrocarbon shows from underlying rocks elsewhere in southwestern Idaho, and the known hydrocarbon deposits within equivalent rocks in the Utah-Wyoming area.

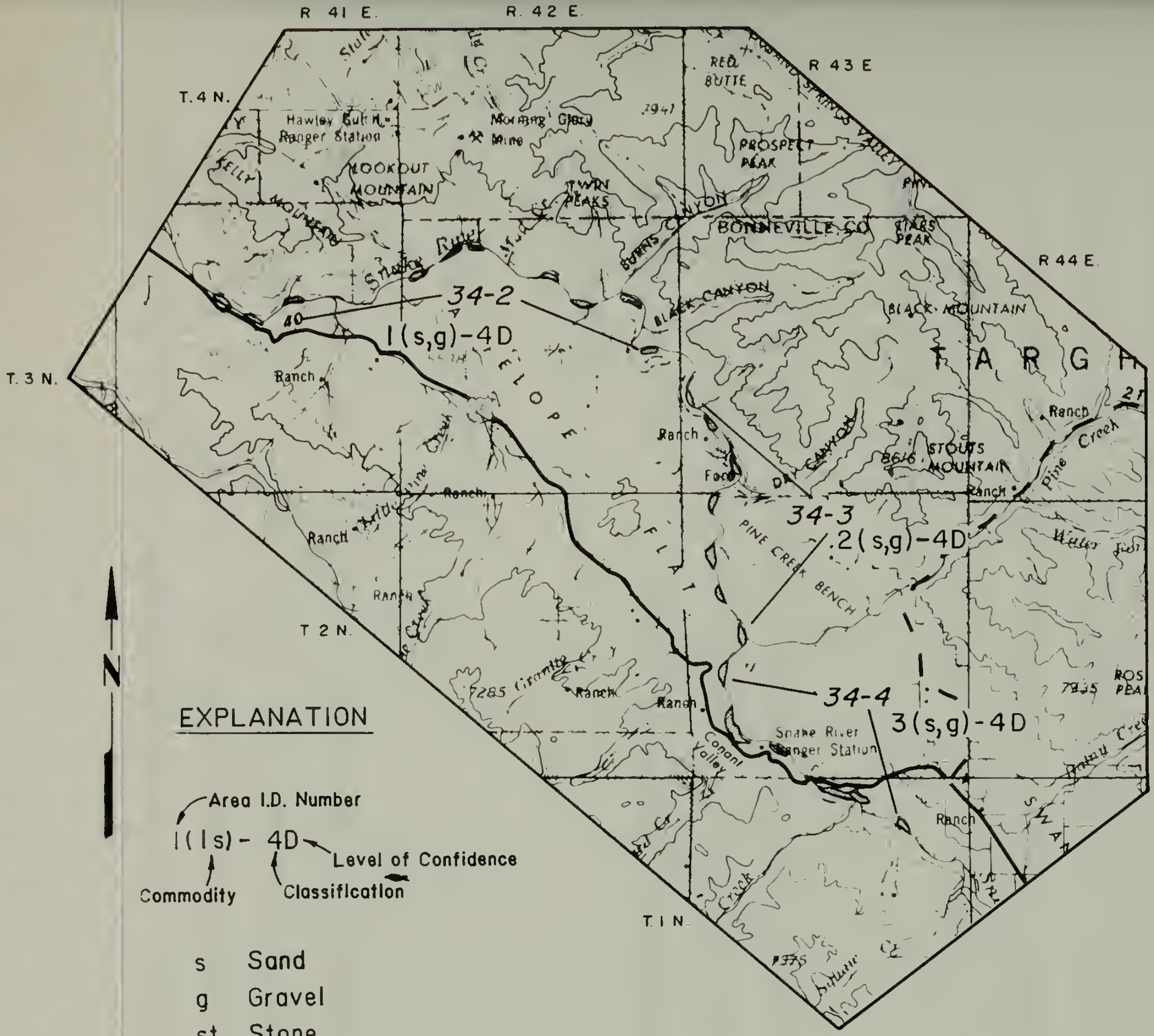
4.2.2b Geothermal. WSA 34-2 (1b, Fig. 20) is classified as having moderate potential for both high and low to intermediate geothermal resources based on indirect evidence (3B). The basis of the classification is the favorable regional setting outlined in Section 3.4.

4.2.2c Sodium and Potassium. The entire area of WSA 34-2 (1c, Fig. 20) is classified as unfavorable for sodium and potassium based on direct evidence 1D. The basis for this classification is the unfavorable geologic setting of the WSA.

4.2.2d Other. WSA 34-2 (1d, Fig. 20) is classified as unfavorable for other leasable resources based on direct evidence (1D). The basis of the classification is the unfavorable structural geology. Although the Phosphoria Formation is probably present in the subsurface, it is far too deep to be economically exploited for phosphate.

4.2.3 Saleable Resources

The entire area of WSA 34-2 (1, Fig. 21) is classified as having high potential for common varieties of sand and gravel based on direct evidence (4D).



BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

LEVELS OF CONFIDENCE

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVLEY MINIMAL TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

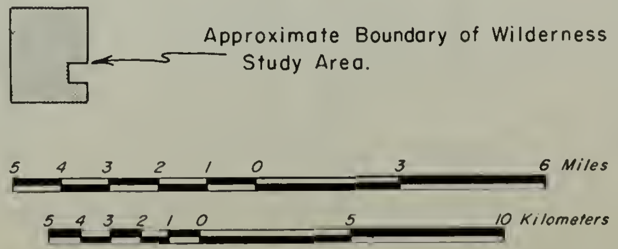
D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

EXPLANATION

1(1s) - 4D

- Area I.D. Number
- Commodity
- Classification
- Level of Confidence

s	Sand
g	Gravel
st	Stone
c	Cinders
p	Pumice
pt	Pumicite
cl	Cloy
Ls	Limestone
dl	Dolomite
P	Peot
pw	Petrified wood


Approximate Boundary of Wilderness Study Area.
5 4 3 2 1 0 3 6 Miles
5 4 3 2 1 0 5 10 Kilometers

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Anchorage, Alaska

BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Snake River GRA, Idaho

Wilderness Study Area
Land Classification
Saleable Resources

SCALE 1" = 4 MILES (1:250,000)		FIGURE
DATA BY. W G M	DATE 9/1982	Revised
DRWN BY DSI	APRVD G.F	21

4.3 Classification of the Pine Creek Islands Wilderness Study Area (34-3)

4.3.1 Locatable Minerals

4.3.1a Metallic Minerals. All of WSA 34-3 (2a, Fig. 19) is classified as having moderate potential for placer gold deposits based on direct evidence (3D). The basis for this classification are the data on concepts discussed in Sections 3.2 and 3.4

4.2.1b Uranium and Thorium. The entire area of WSA 34-3 (2b, Fig. 19) is classified as having low potential for uranium mineralization based on inadequate evidence (2A). The WSA is underlain by recent alluvial deposits and several thousand feet of volcanics and coarse clastics. Although the coarse clastics might constitute a favorable depositional environment for uranium, no data is available.

4.2.1c Non-Metallic Minerals. The entire area of WSA 34-3 (2c, Fig. 19) is classified as unfavorable for locatable non-metallic minerals based on direct evidence (1D). The geological setting of the WSA is unfavorable for these deposits.

4.3.2 Leasable Resources

4.3.2a Oil and Gas. WSA 34-2 (2a, Fig. 20) is classified as having moderate potential for oil and gas resources based on minimal direct evidence (3C). The reasons for the classification are the inferred favorable geologic processes, the reported hydrocarbon shows from underlying rocks

elsewhere in southeastern Idaho, and the known hydrocarbon deposits within equivalent rocks in the Utah-Wyoming area.

4.3.2b Geothermal. All of of WSA 34-2 (2b, Fig. 20) is classified as having moderate potential for both high and low to intermediate geothermal resources based on indirect evidence (3B). The basis of the classification is the favorable regional setting outlined in Section 3.4.

4.3.2c Sodium and Potassium. The entire area of WSA 34-2 (2c, Fig. 20) is classified as having no potential for sodium and potassium based on direct evidence 1D. The basis for this classification is the unfavorable geologic setting of the WSA.

4.3.2d Other. WSA 34-2 (2d, Fig. 20) is classified as unfavorable for other leasable resources based on direct evidence (1D). The basis of the classification is the unfavorable structural geology. Although the Phosphoria Formation is probably present in the subsurface, it is far too deep to be economically exploited for phosphate.

4.3.3 Saleable Resources

The entire area of WSA 34-2 (2, Fig. 21) is classified as having high potential for common varieties of sand and gravel based on direct evidence (4D).

4.4 Classification of the Conant Valley Islands Wilderness Study Area (WSA 34-4)

4.4.1 Locatable Minerals

4.4.1a Metallic Minerals. The entire area of WSA 34-4 (3a, Fig. 19) is classified as having moderate potential for placer gold deposits based on direct evidence (3D). The basis for this classification are the concepts discussed in Sections 3.2 and 3.4.

4.4.1b Uranium and Thorium. All of WSA 34-4 (3b, Fig. 19) is classified as having low potential for uranium mineralization based on inadequate evidence (2A). The WSA is underlain by recent alluvial deposits and several thousand feet of volcanics and coarse clastics. Although the coarse clastics might constitute a favorable depositional site for uranium, no data is available.

4.4.1c Non-Metallic Minerals. The entire area of WSA 34-4 (3c, Fig. 19) is classified as unfavorable for locatable non-metallic minerals based on direct evidence (1D). The geological setting of the WSA is not favorable for these deposits.

4.4.2 Leasable Resources

4.4.2a Oil and Gas. WSA 34-4 (3a, Fig. 20) is classified as having moderate potential for oil and gas resources based on minimal direct evidence (3C). The reasons for the classification are the inferred geologic processes, the reported hydrocarbon shows from underlying rocks elsewhere in

southeastern Idaho, and the known hydrocarbon deposits within equivalent rocks in the Utah-Wyoming area.

4.2.2b Geothermal. All of WSA 34-4 (3b, Fig. 20) is classified as having moderate potential for both high and low to intermediate geothermal resources based on indirect evidence (3B). The basis of the classification is the favorable regional setting outlined in Section 3.4.

4.4.2c Sodium and Potassium. The entire area of WSA 34-4 (3c, Fig. 20) is classified as having no potential for sodium and potassium based on direct evidence 1D. The basis for this classification is the unfavorable geologic setting of the WSA.

4.4.2d Other. WSA 34-4 (3d, Fig. 20) is classified as unfavorable for other leasable resources based on direct evidence (1D). The basis of the classification is the unfavorable structural geology. Although the Phosphoria Formation is probably present in the subsurface, it is far too deep to be economically exploited for phosphate.

4.4.3 Saleable Resources

The entire area of WSA 34-4 (3, Fig. 21) is classified as having high potential for common varieties of sand and gravel based on direct evidence (4D).

5.0 RECOMMENDATIONS FOR FURTHER WORK

The WSAs comprise over 40 islands scattered over a river segment over 25 miles in length. Due to the relatively limited acreage within the WSAs, exploration for natural resources by private industry elsewhere in the Snake River GRA is unlikely to be impeded. The following recommendations are regional in scope and are impractical when limited to the WSAs.

The uranium potential of the coarse clastics filling the Swan Valley-Star Valley graben can be assessed by conducting a spring water geochemical reconnaissance in the two valleys. This information would also be useful in assessing the geothermal potential of the region.

Further study to assess the hydrocarbon potential should consist of the following:

A. Potential source beds other than the Phosphoria should be characterized and analyzed for thermal maturity. This will indicate the types of hydrocarbons to be expected in the area and delineate those horizons where burial depths have removed hydrocarbons.

B. Conodont color alteration studies should be made from the Paleozoic and Triassic limestones, sands, and shales. This will also indicate the types of hydrocarbons to be expected and horizons where burial depths have been excessive.

C. Geophysical studies of the Grand-Swan Valley lowland should be made using modern techniques. This will provide an interpretation of the subsurface structure of the lowland and help locate the most favorable drill sites. This is particularly important for WSAs 34-2 to 34-4 since the Tertiary basalts and conglomerates have completely masked the underlying structure.

Evaluation of the geothermal resources will require major efforts because of the size of the Snake River GRA and the relatively unknown geology, hydrology, and geophysics. Geologic mapping of the Antelope Flat area and dating of the young volcanics is necessary. Geothermal gradient drilling (500-1,000 ft. holes) along the length of the WSAs at a spacing of 1-2 km is also necessary. A microearthquake survey of about one-month duration to accurately locate active faults that might occur within the WSAs also should be part of the geothermal evaluation. Geochemical analysis of any fluids encountered in the drilling should be carried out to locate geothermal aquifers that might be covered by cold water aquifers in the area of permeable surface rocks and unknown hydrology. If deep hydrocarbon tests are drilled in this area, temperature measurements should be made in the wells to evaluate the geothermal potential of the area. Flow tests of any high temperature aquifers encountered should also be carried out.

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APPENDIX I

Wilderness Study Area Maps

34–2
TABLE ROCK ISLANDS

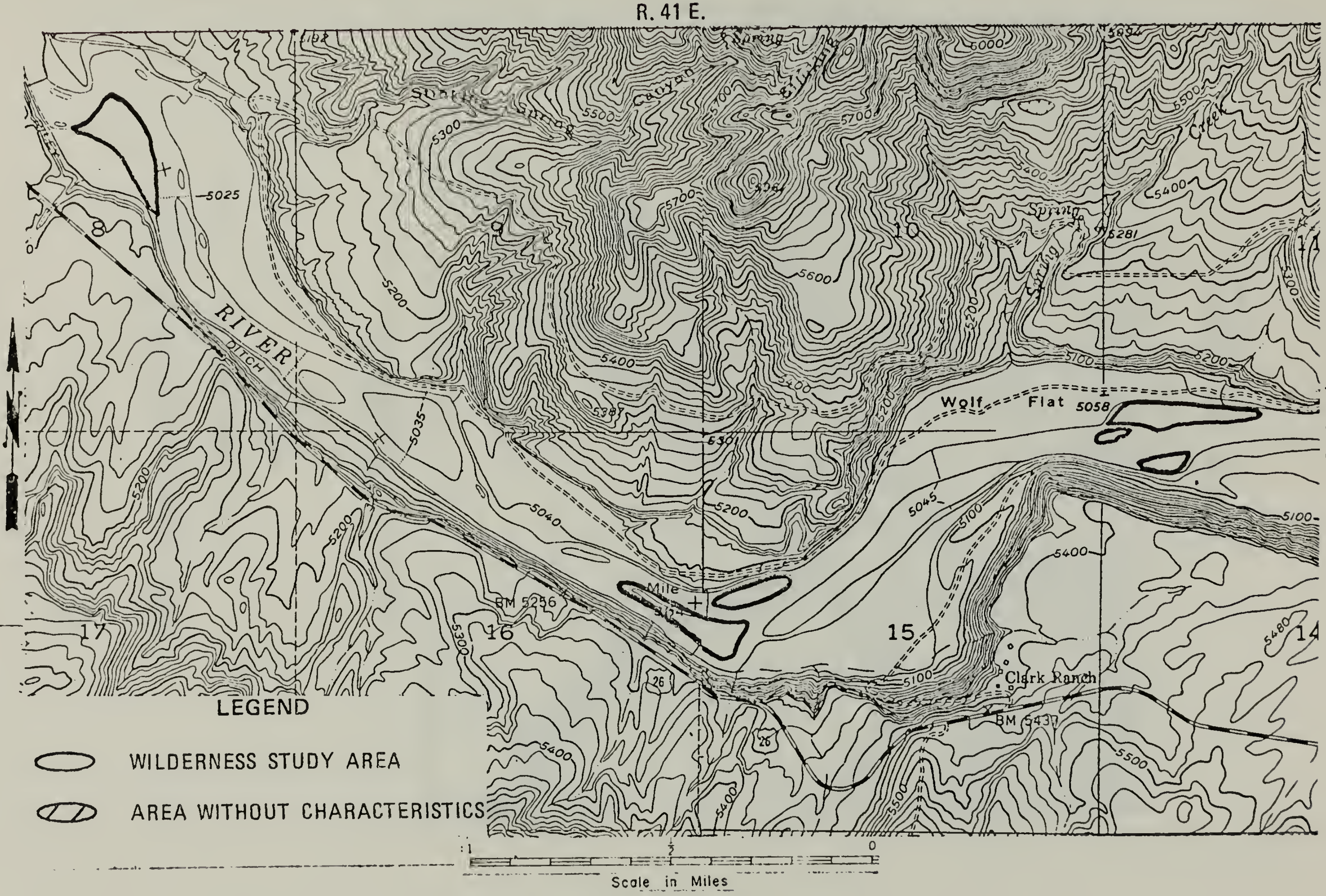

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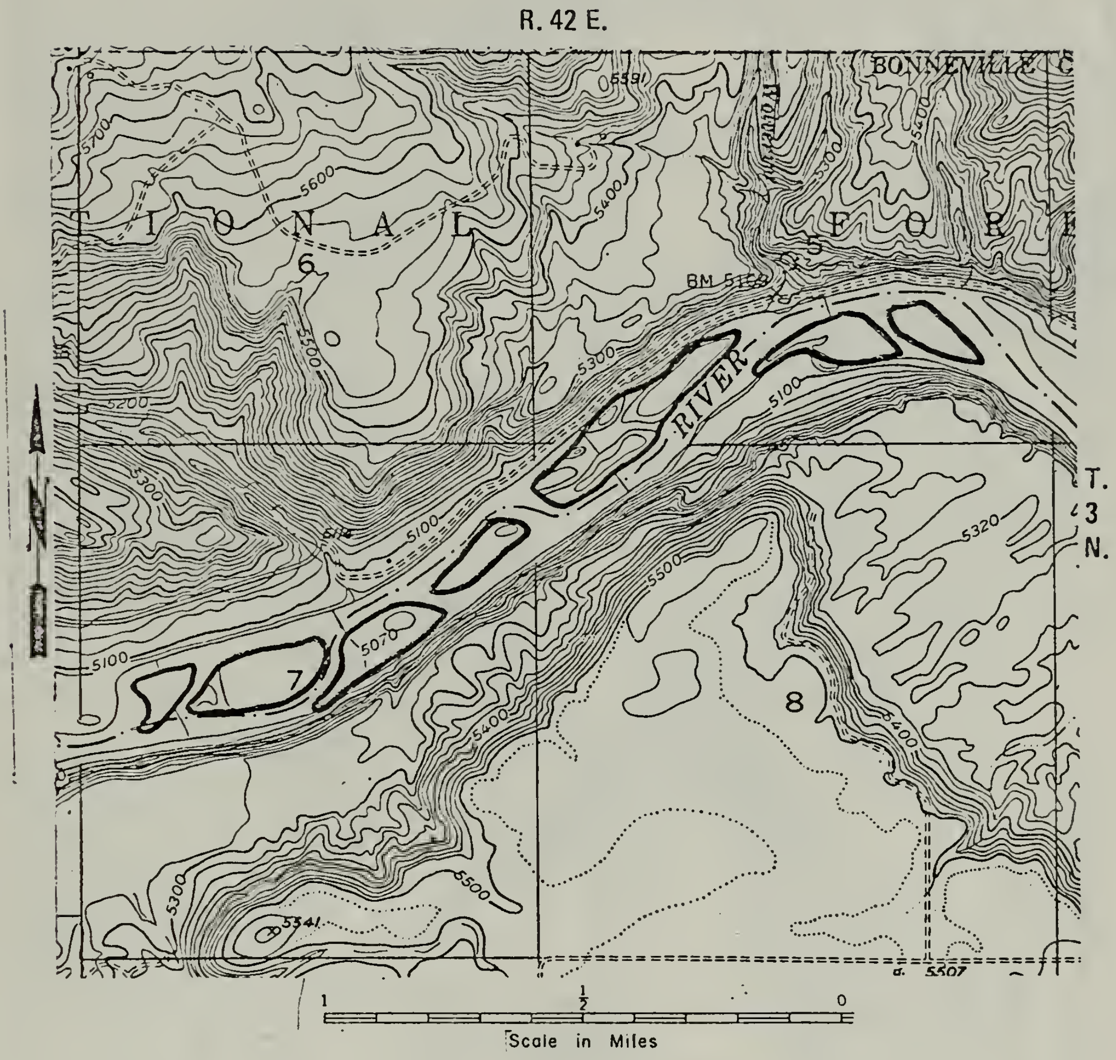
TABLE ROCK ISLANDS

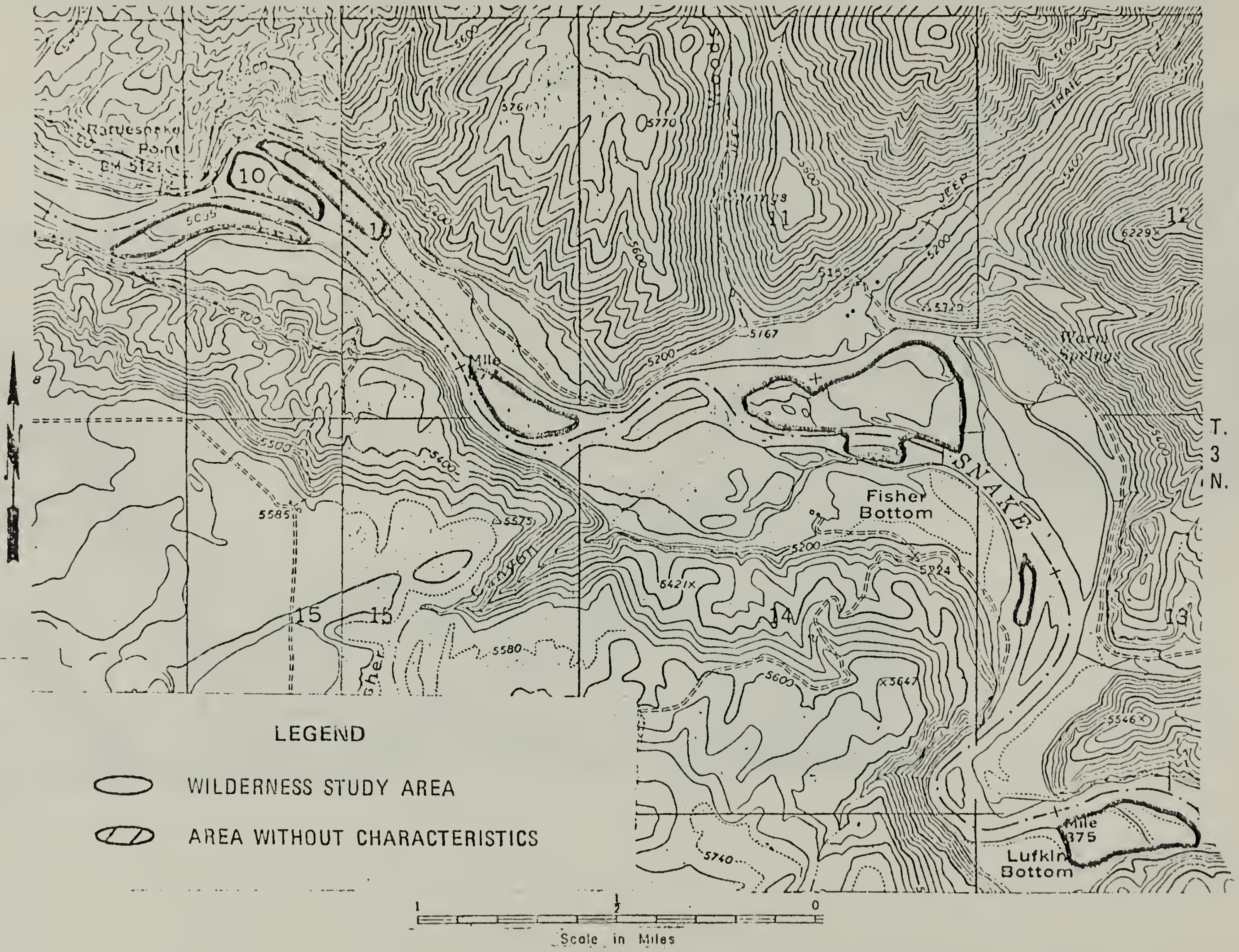


LEGEND

⬭ WILDERNESS STUDY AREA

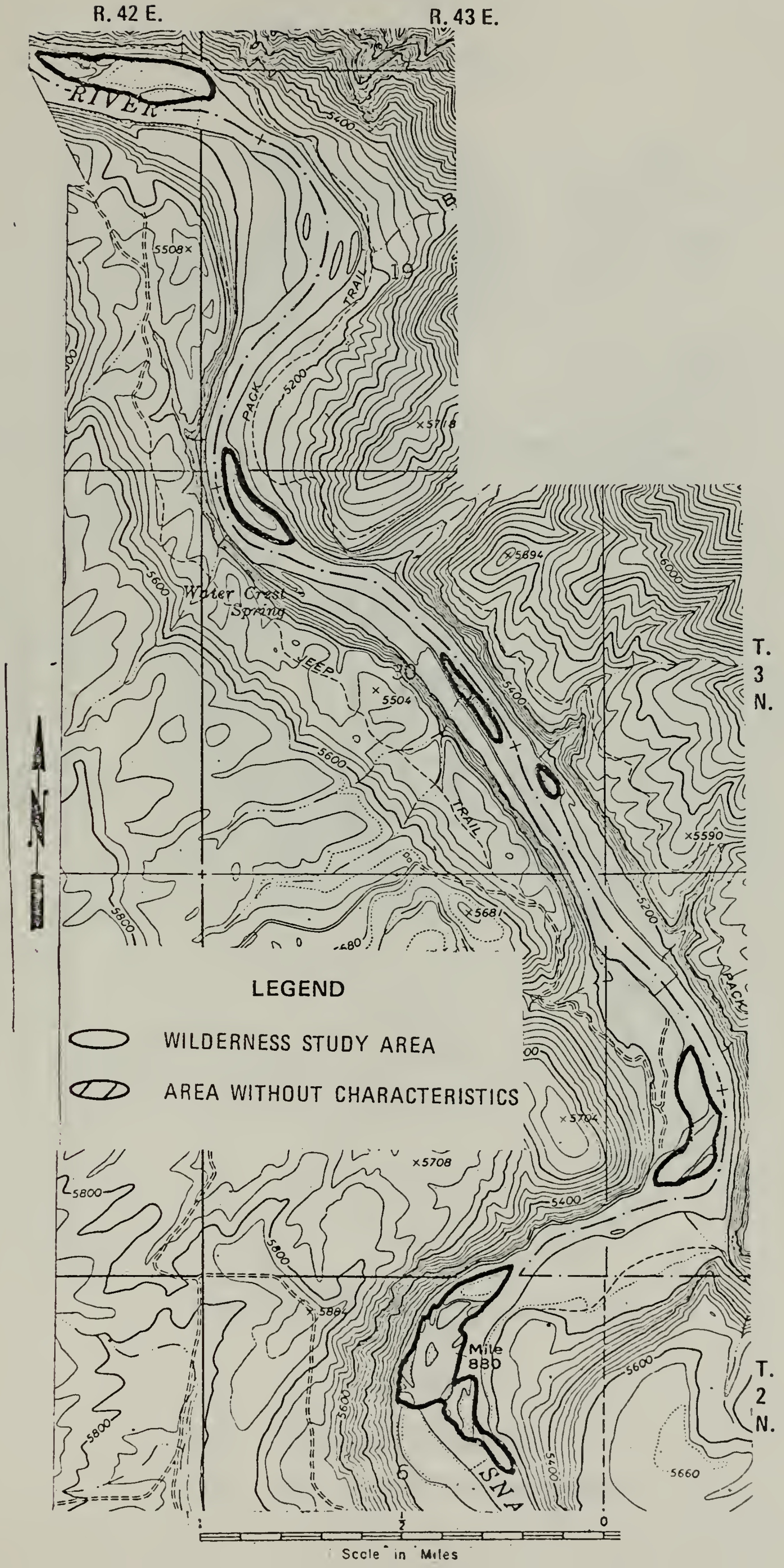
▨ AREA WITHOUT CHARACTERISTICS

34–2
TABLE ROCK ISLANDS



34–3

PINE CREEK ISLANDS



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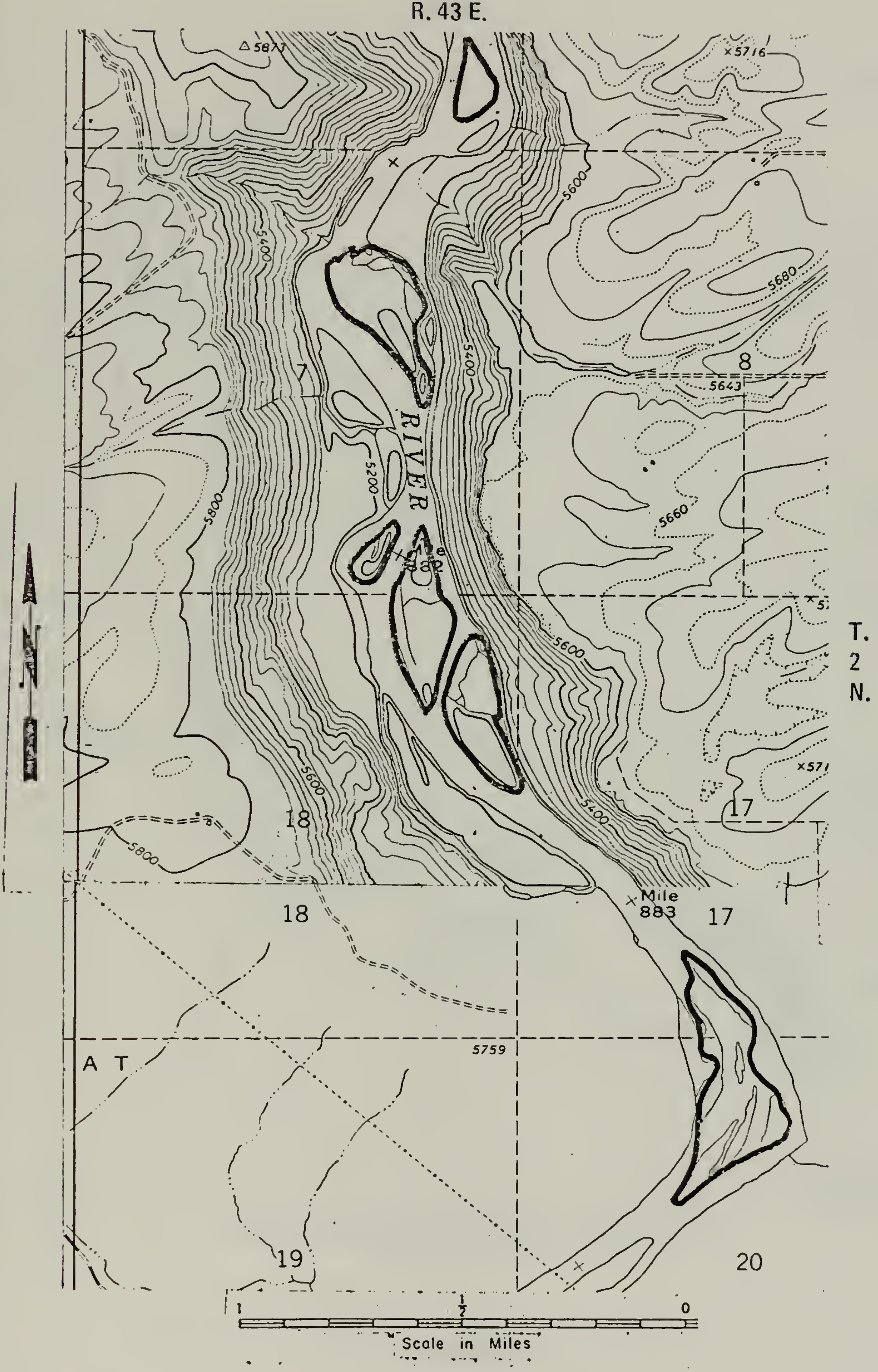
PINE CREEK ISLANDS

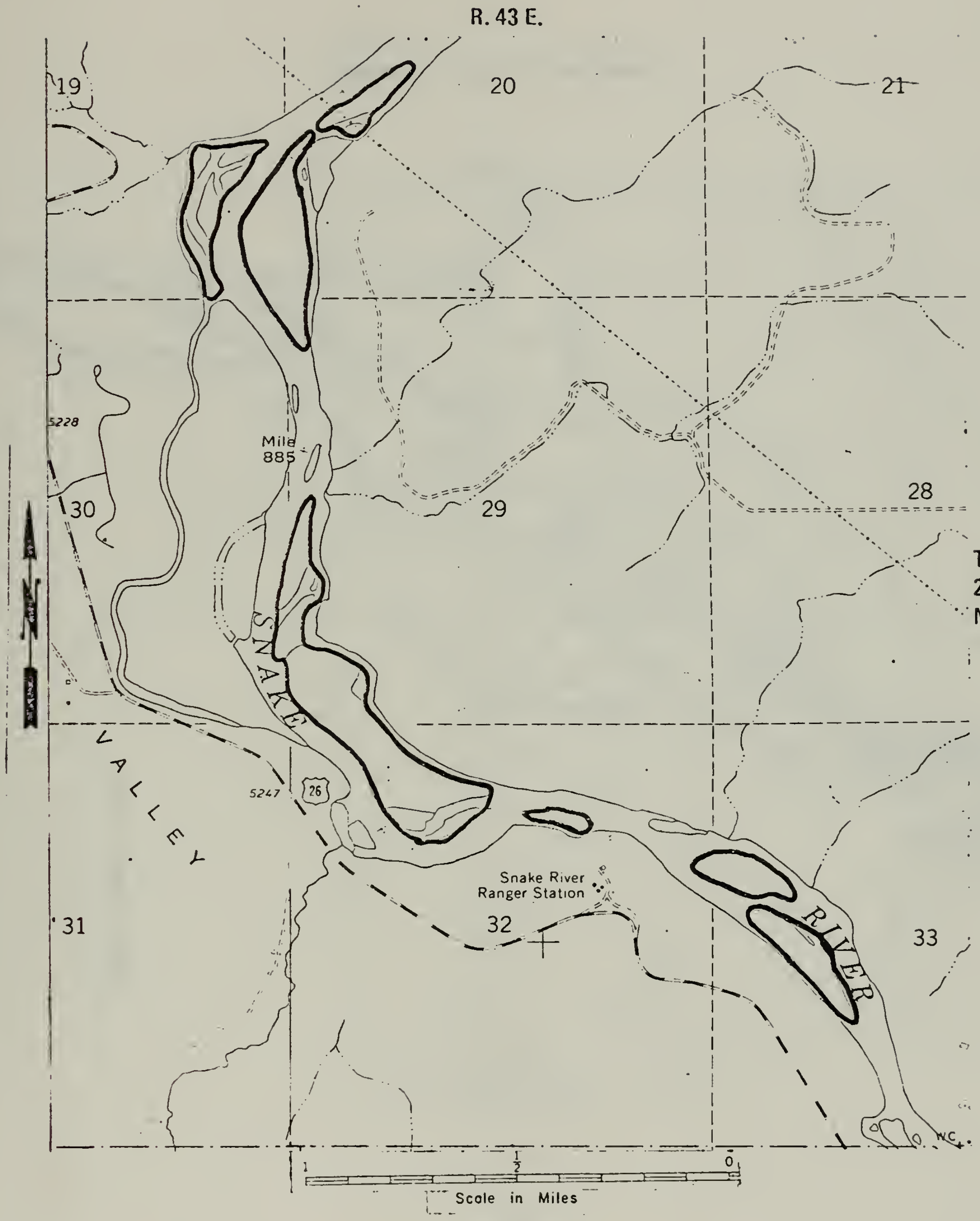


LEGEND

⬭ WILDERNESS STUDY AREA

▨ AREA WITHOUT CHARACTERISTICS

34–4
CONANT VALLEY ISLANDS



LEGEND

⬭ WILDERNESS STUDY AREA

▨ AREA WITHOUT CHARACTERISTICS

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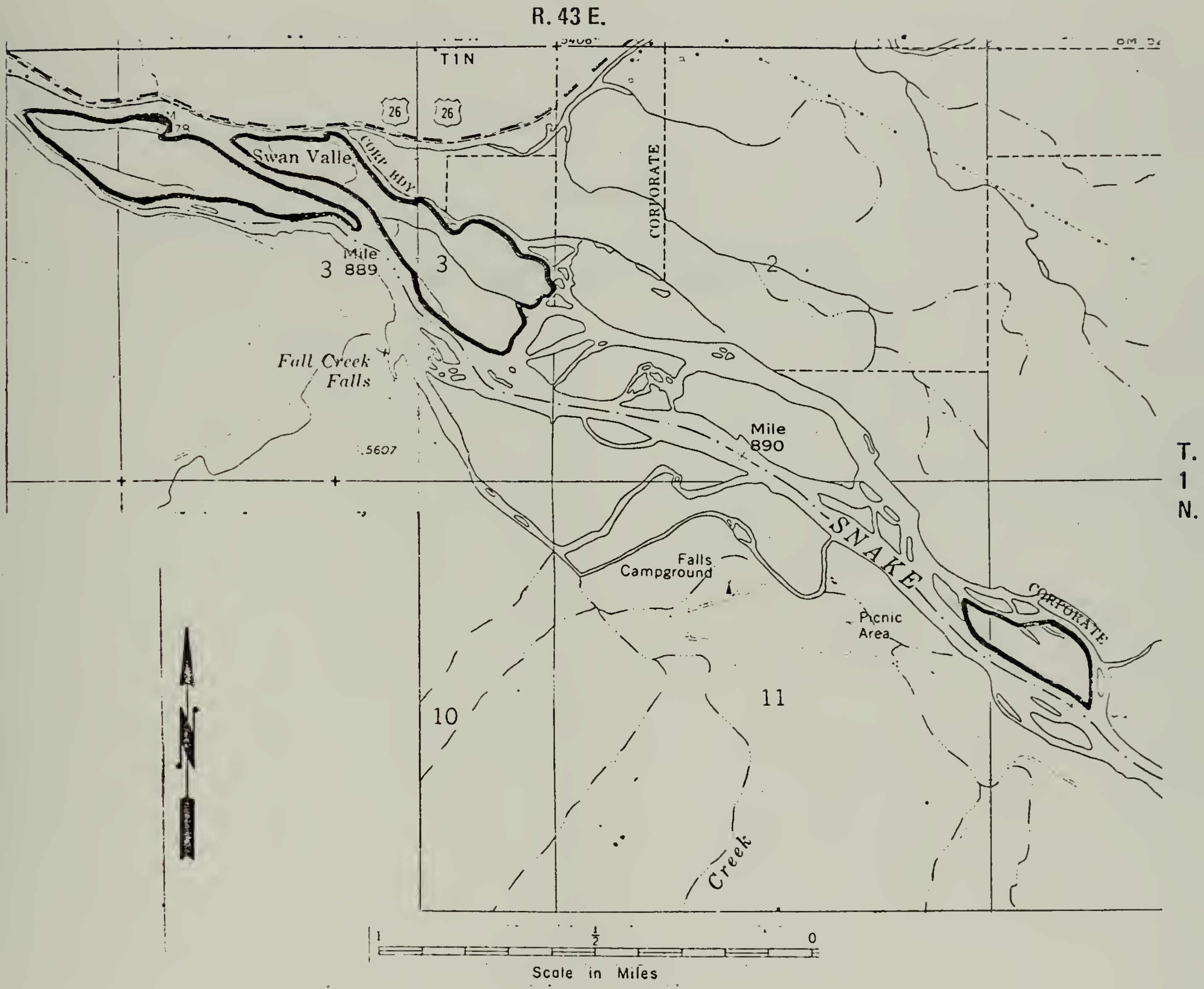
CONANT VALLEY ISLANDS



LEGEND

○ WILDERNESS STUDY AREA

▨ AREA WITHOUT CHARACTERISTICS

APPENDIX II

Oil and Gas Well Summary Sheet

GEM PROJECT - OIL AND GAS WELL SUMMARY SHEET

GRA Snake River

Well: Meadow Creek-Sorenson No. 1

Company: California Oil Company

Location: Sec. 33 T. 3N R. 41E

Date Drilled: 1928-1930

Elevation: 5,849 ft.

Status: Abandoned

Total Depth: 3,774 ft.

Production: None

Notes:

1. Unconfirmed report of "asphaltic material discovered during "drilling" (Savage, 1961).
2. Water at 481-485 ft. and 1,214-1,221 ft.
3. Well also known as Bonneville No. 1

Source of Data:

Id. Oil & Gas Cons. Bur.
Savage (1961)

Date Checked: 8-11-82 By: GF

Log:

0- 20	Lava Boulders
20- 250	Nugget
250- 815	Ankareh
815-1980	Thaynes
1980-2438	Woodside
2438-3425	Dinwoody
3425-3662	Phosphoria
3662-3774	Wells

- Log from Savage (1961) p. 69 based on review of lithologic descriptions in I.O.G.C.B. file.

Form 1279—3
(June 1984)

BORROWER'S

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Fernette, Greg.
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DATE LOANED	BORROWER

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